Prepared for:
BNSF Railway Company
80 44th Avenue Northeast
Minneapolis, Minnesota 55421

Rail Maintenance Worker Receptor Activity-Based Sampling and Analysis Plan

Operable Unit 6
Libby, Montana, Superfund Site

ENSR Corporation
October 2008
Document No.: 01140-228-100

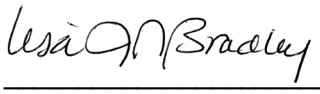
ENSR | AECOM

Prepared for:
BNSF Railway Company
80 44th Avenue Northeast
Minneapolis, Minnesota 55421

Rail Maintenance Worker Receptor Activity-Based Sampling and Analysis Plan

Operable Unit 6
Libby, Montana, Superfund Site

Prepared By
Laura Trozzolo



Reviewed By
Lisa JN Bradley, Ph.D., DABT

ENSR Corporation
October 2008
Document No.: 01140-228

ENSR | AECOM

Approval Page

This Rail Maintenance Worker Receptor Activity-Based Sampling and Analysis Plan for Operable Unit 6 of the Libby, Montana, Superfund Site have been prepared for the U.S. Environmental Protection Agency, Region 8, by BNSF Railway Company (BNSF), ENSR, and EMR. Study activities addressed in this Plan are approved.

_____ _____

Kathryn Hernandez
Team Leader, Libby Site

Date

List of Acronyms

ABS	Activity-Based Sampling
AHERA	Asbestos Hazard Emergency Response Act
AIHA	American Industrial Hygiene Association
BNSF	Burlington Northern Santa Fe
cc	cubic centimeters
CDM	CDM Federal Programs Corporation
COC	Chain-of-Custody
DQOs	Data Quality Objectives
EDD	Electronic Data Deliverable
ERT	Emergency Response Team
FCO	Field Change Order
FSDS	Field Sample Data Sheet
FSP	Field Sampling Plan
GPS	Global Positioning System
HASP	Health and Safety Plan
IDW	Investigation Derived Waste
IH	Industrial Health
ISO	International Organization for Standardization
L/min	Liters Per Minute
LA	Libby Amphibole asbestos
MCE	Mixed-Cellulose Ester
MET	Meteorological
mm	Millimeter
MP	Milepost
NIOSH	National Institute for Occupational Safety and Health
NOAA	National Oceanic Atmospheric Administration
NVLAP	National Voluntary Laboratory Accreditation Program
OSHA	Occupational Safety and Health Administration
OU	Operable Unit
PAT	Proficiency Analytical Testing
PCM	Phase Contrast Light Microscopy
PM	Project Manager
PPE	Personal Protective Equipment
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RI/FS	Remedial Investigation/Feasibility Study
ROW	Right-of-Way
SAP	Sampling and Analysis Plan
SOP	Standard Operating Procedure
TEM	Transmission Electron Microscopy

TL	Team Leader
USEPA	United States Environmental Protection Agency

Contents

List of Appendices

Appendix presented in the Rail Maintenance Public Receptor Activity-Based Sampling and Analysis Plan for Operable Unit 6

List of Tables

List of Figures

1.0 Introduction

This document is the Rail Maintenance Worker Receptor Activity-Based Sampling and Analysis Plan (SAP) for the collection and analysis of outdoor air samples in the immediate vicinity of rail maintenance activities that may actively disturb outdoor soil on portions of BNSF Railway Company (BNSF) Right-of-Way (ROW), which is located within Operable Unit (OU) six of the Libby, Montana, Superfund Site. OU6 includes approximately 42 miles of BNSF ROW from Milepost (MP) 1302 to 1341. The ROW extends approximately 50 feet on either side of the track. The majority of this track travels along the Kootenai River and passes through the towns of Libby and Troy, Montana. The planned rail maintenance activities will encompass track between MP 1312 to MP 1341, which runs through both rural and urban areas. **Figure 1-1** depicts the locations of the scheduled rail maintenance activities.

BNSF has a unique opportunity to collect site-specific data in advance of the finalization of the Order as maintenance of track between MP 1312 to MP 1341 between September 17, 2008 and September 25, 2008. Because of the track protection provided by the railroad during the maintenance activities (i.e., active trains will not be using those sections of track), sampling can occur along the ROW in a manner that adheres to health and safety protocols. BNSF agrees with USEPA that conducting air sampling during this maintenance event, concurrent with the collection of soil samples, will provide valuable information for scoping the Remedial Investigation/Feasibility Study (RI/FS) Work Plan for OU6. This SAP is a companion document to the "Rail Maintenance Public Receptor Activity-Based Sampling and Analysis Plan for Operable Unit 6," also referred to here as the Public Receptor SAP, submitted to USEPA on September 23, 2008.

This SAP contains the elements required for both a field sampling plan (FSP) and quality assurance project plan (QAPP). This SAP has been developed in accordance with the USEPA Requirements for Quality Assurance Project Plans (USEPA 2001), the Guidance on Systematic Planning Using the Data Quality Objectives Process – USEPA QA/G4 (USEPA 2006), and the project documents currently in place for the Libby Asbestos Site. The project-specific procedures for this SAP are presented in Appendix A of the Public Receptor SAP. The SAP is organized as follows:

Chapter 1.0 – Introduction

Chapter 2.0 – Sampling Program

Chapter 3.0 – Laboratory Analysis and Requirements

Chapter 4.0 – Assessment and Oversight

Chapter 5.0 – Data Validation and Usability

Chapter 6.0 – Project Schedule

Chapter 7.0 – References

1.1 Sampling Overview

Data Quality Objectives (DQOs) are statements that define the type, quality, quantity, purpose and use of data to be collected. The design of a study is closely tied to the DQOs, which serve as the basis for important decisions regarding key design features, such as the number and location of samples to be collected and the chemical analyses to be performed. The specific DQOs for rail maintenance activity-based sampling (ABS) are detailed in the Public Receptor SAP. Therefore, please consult the Public Receptor SAP for all DQO discussions.

The ROW medium to be sampled includes breathing zone air via personal sampling monitors. It should be noted that the rail lines are laid upon several inches of ballast material, which is not amenable to direct

sampling for asbestos (CDM 2007). Therefore, the soil samples will be collected from the ROW locations adjacent to the ballast, in areas where a receptor could walk. The source of asbestos in air for rail maintenance workers is presented in **Figure 1-2**. Generally, rail maintenance activities are confined to the rail and ballast area of the track; therefore, the source of asbestos in air would likely be from the ballast area.

Thus, the primary purpose that this SAP seeks to address is in collecting ABS outdoor air data and industrial health (IH) samples (that BNSF collects as part of their OSHA compliance activities) as part of OU6 maintenance activities [between MP 1312 to MP 1341]. The IH data will be used for BNSF's worker health and safety program, and the ABS data will be used to support risk assessment and risk management decisions, as well as provide valuable information in scoping the RI/FS Work Plan for OU6.

1.1.1 Sampling Locations

Sampling locations are to be determined by the locations of the planned rail maintenance activities. As these locations are defined by BNSF to meet rail operational needs, the exact locations identified herein are subject to change. However, the goal is to conduct ABS sampling at the majority, if not all, of the locations. Topography, accessibility and health and safety requirements will determine whether all rail maintenance locations can be safely sampled.

As of this writing, there are approximately 12 maintenance locations between MP 1312 and MP 1341, each location requiring approximately one-half of a working day to complete the maintenance activities. The majority of the maintenance activities at each location involve rail replacement and minor track realignment using a Steel Gang. See **Table 1-1** for a general description of the rail maintenance activities planned at each location.

1.1.2 Types of Samples

For the rail maintenance receptor scenario, two categories of personal air samples will be collected.

1.1.2.1 ABS Personal Air Samples

Experience at Libby and at other sites has demonstrated that, in general, personal air samples (i.e., samples that collect air in the breathing zone of a person) tend to be higher in concentration than air samples collected by a stationary monitor, especially if the person is engaged in an activity that disturbs an asbestos source such as contaminated soil. Because of this, this SAP will focus on the collection of ABS personal air samples during rail maintenance activities.

1.1.2.2 OSHA Personal Air Samples

All personnel whose work has the potential to disturb soils or ballast in areas known or assumed to be impacted by the presence of asbestos shall be part of a monitoring program, per 29 CFR 1910.1001, which includes collection of initial and periodic personnel air sampling. BNSF, or BNSF's authorized agent, will conduct sampling of representative personnel.

1.1.3 Target Analyte List

Each air sample that is collected must be analyzed for asbestos particles. Specific methods and counting rules are provided in Section 3.0. Results should include the size (length, width) of each particle, along with the mineral classification (Libby amphibole (LA), other amphibole, chrysotile).

1.1.4 Types of Soil Disturbances

Workers may disturb soil within the ROW by several different activities. This assessment will focus on rail maintenance activities which are considered to be realistic examples of relatively vigorous disturbances, as detailed in Table 3-1.

1.2 Define the Bounds of the Study

The following sections pertain to the air samples to be collected for the rail maintenance workers. The IH samples will be collected in accordance with 29 CFR 1910.1001.

1.2.1 Spatial Bounds

The spatial bounds of this study are restricted to the extent of the railroad ROW (approximately 50 feet on either side of the track) between MP 1312 and MP 1341 of OU6 where rail maintenance activities will occur in September 2008. This length traverses rural areas east of Libby between Libby and Troy, as well as urban areas of Troy.

1.2.2 Temporal Bounds

Estimation of human health risk from exposure to LA in outdoor air following a series of active outdoor soil disturbances will be based on the average concentration that occurs across the series of disturbances. Because the level of LA in outdoor ABS air may depend on factors that vary seasonally (disturbance patterns, soil moisture, wind speed, humidity, etc.), the data set needed for this effort should ideally consist of multiple samples from each area, spanning a range of time points and meteorological conditions. Note that rail maintenance activities are not regularly scheduled during the winter months. However, because OU6 is an active rail line, the sampling proposed in this SAP is limited to times and locations where rail maintenance is planned. This is due to the fact that rail maintenance ABS must be conducted during rail maintenance activities. While ideally, samples collected as part of the upcoming rail maintenance activities should be collected under conditions when the soil is relatively dry (less than 1/10-inch of rain within the past 36 hours), and a field moisture deficiency of at least 50 percent to help ensure that the data are not biased low, samples will be collected no matter what preceding rainfall may occur. Prior weather conditions will be noted in the field notebooks. However, ABS will generally not be conducted if it is actively raining; although, if rain does occur during the course of the sampling event, sampling will continue and the rain will be noted in the field notebooks. During days when outdoor ABS activities are scheduled, meteorological (MET) weather station data will be downloaded from the local National Oceanic Atmospheric Administration (NOAA) station, LBBM8, to calculate the total accumulation of rain. During sampling activities, rain accumulation will be monitored onsite by a portable MET station.

2.0 Sampling Program

The following sections summarize field activities that BNSF will perform during the rail maintenance ABS investigation. All activities will be performed in accordance with this SAP, in addition to BNSF Data Collection and Management Policies and Procedures (presented in **Appendix A** of this report). Field personnel will refer to the following OU6 Rail Maintenance SAP Project-Specific Procedures sections presented in Appendix A of the Public Receptor SAP for details regarding requirements referenced in this SAP:

QAPP Section Number	Section Title
1.0	Field Planning Meetings
2.0	Field Team Training Requirements
3.0	Equipment Decontamination
4.0	Field Logbooks
5.0	Field Sample Data Sheets (FSDSs)
6.0	Photographic Documentation
7.0	Global Positioning System (GPS) Point Collection
8.0	Equipment Calibration
9.0	Field Equipment Maintenance
10.0	Handling Investigation Derived Waste (IDW)
11.0	Field Sample Custody and Documentation
12.0	Sample Packaging and Shipping
13.0	Modification Forms
14.0	Laboratory Analysis and Requirements - Related QA/QC Procedures
15.0	Laboratory Custody Procedures and Documentation
16.0	Documentation and Records
17.0	Data Recording, Management and Reporting

The project-specific procedures and Libby standard operating procedures (SOPs) to be followed during this sampling event are included as attachments to Appendix A of the Public Receptor SAP, and are listed in the Table of Contents therein.

2.1 Pre-Sampling Activities

Prior to beginning ABS field activities, sampling locations will be selected, community coordination will be conducted by USEPA, a field planning meeting will be conducted, any required trainings will be conducted, and an inventory and procurement of supplies will be performed. In addition, the Health and Safety Plan (HASP) (presented in Appendix B of the Public Receptor SAP) will be reviewed and acknowledged by all members of the sampling team.

2.1.1 Selection of Sampling Locations

As discussed in Section 3.3, sample locations are dictated by the rail maintenance activities schedule.

2.1.2 Community Coordination

The work described in this SAP will be conducted on BNSF ROW property. Private property will not be accessed.

2.1.3 Field Planning Meeting

A field planning meeting will be conducted in accordance with the procedures detailed in Section 1.0 of the Project-Specific Procedures, as presented in Appendix A of the Public Receptor SAP. Details about the objectives of the sampling, plans for sample collection, and Health and Safety considerations will be shared with all members of the sampling team.

2.1.4 Training Requirements

Training requirements described in Section 2.0 of the Project-Specific Procedures, as presented in Appendix A of the Public Receptor SAP, will apply to personnel conducting sample collection activities described in this SAP. In addition, any personnel accessing the ROW during the rail maintenance activities must have the following BNSF rail-specific training:

- The BNSF Contractor Orientation, which can be accessed at http://www.contractororientation.com/.
- Erailsafe consent form, which should be completed by the person or persons that will be overseeing the work and then the form should be returned to EMR with a “head and shoulders” digital photo. After that, EMR will put those personnel into the system, at which point, they must complete a test to receive their badge.

2.1.5 Inventory and Procurement of Equipment and Supplies

The following equipment is needed for sampling activities, and will be procured by EMR Incorporated prior to initiation of sampling activities:

- Field logbooks;
- Indelible ink pens;
- Digital camera;
- Video camera;
- Sample cassettes: 0.8 um pore, 25 millimeter (mm) diameter, mixed cellulose ester (MCE) filter cassettes;
- Sample paperwork and sample tags/labels;
- Custody seals;
- Zipper-top baggies;
- Air sampling pumps;
- Tygon tubing;
- Rotameters;

- Personal protective equipment (PPE) as required by the site Health and Safety Plan (HASP);
- High volume air pumps;
- Portable MET Station; and
- GPS device.

For the IH sampling, the following equipment is needed:

- Battery-powered personal sample pumps;
- Dedicated tubing;
- Sample cassettes;
- Zipper-top baggies;
- Sample paperwork and sample tags/labels;
- Rotameters;
- Field logbooks; and
- Indelible ink pens.

2.2 Sample Collection

As noted above, the goal is to collect both OSHA personal air samples and ABS personal air samples for rail maintenance activities conducted by the worker receptor. The following sections describe the ABS sample collection procedure for each sampling event.

2.2.1 OSHA Personal Air Sampling

BNSF, or BNSF's authorized agent, will determine the geographic extent of soils likely impacted by asbestos at a level sufficient to cause worker exposure to exceed the established Time Weighted Average and/or the excursion limits as defined in 29 CFR 1910.1001. BNSF will provide for air monitoring by an experienced industrial hygiene professional to collect personnel air samples. Initial monitoring will be completed to determine actual concentrations in the breathing zone of the workers during specified work activities. Personnel to be sampled will be at the discretion of the industrial hygienist and will constitute either twenty five percent (25%) of the entire work force or at least one person from each job classification in each work area, whichever is greater. It will be determined by the hygienist, utilizing information from the crew foreman, which workers are represented by which sample and that information will be documented in daily logs. Different personnel may be sampled daily at the discretion of the hygienist.

Samples will be collected and analyzed per 29 CFR 1910.1001, Appendices A and B. This includes but is not limited to samples being collected utilizing battery powered personal sample pumps, dedicated tubing, and new sample cassettes. Sample pumps will be secured to the workers and the sample cassettes will be placed in the breathing zone of the worker. Sample start times, employee identification numbers for those personnel participating in the air monitoring program, and flow rates will be recorded on sample forms or daily logs upon start up and stopping of maintenance work each day.

For work lasting longer than 30 minutes, one sample shall be collected from each person being monitored each day; the monitoring shall be conducted during the full work shift to assure that all potential exposures are represented. This sample is to be collected is such a way that it is representative of potential maximum

exposure as determined by the industrial hygienist utilizing historical information and/or correspondence with the crew foreman. Data collected shall be compiled in a manner consistent with standard industrial hygiene practice to prepare an 8-hour time weighted average, which will be utilized by the industrial hygienist to evaluate personnel protective equipment.

Monitoring shall be repeated at any time that work practices change in such a way that causes the potential for release of asbestos fibers or every six months until such time that exposures are statistically below the TWA for a particular work activity, BNSF reserves the right to discontinue monitoring per 29 CFR 1910.1001 at such a time.

2.2.2 ABS Personal Air Sampling

Sampling will occur over several hours, depending on the duration of maintenance activities at each location. The activities to be conducted will occur concurrently:

- Receptors 1 and 2 – rail maintenance workers (see **Table 2-1**).

Outdoor air sampling will be conducted consistent with the approach outlined in USEPA Emergency Response Team (ERT) SOP #2084, Activity-Based Air Sampling for Asbestos, with project-specific modifications (Appendix A of the Public Receptor SAP).

Personal Air Samples

Personal air samples will be collected from the breathing zones of the event participants consistent with the approach in USEPA ERT SOP #2084, Activity-Based Air Sampling for Asbestos, with project-specific modifications, provided in Appendix A of the Public Receptor SAP. The breathing zone can be visualized as a hemisphere approximately 6 to 9 inches around an individual's face. The maximum flow rates for sample collection are targeted at 5 liters per minute (L/min) for maintenance workers over a 4 hour period resulting in a target volume of 1,200 L. This flow rate was chosen for this sampling event in order to maximize the volume of air collected which, in turn, helps achieve the analytical sensitivities required for risk assessment evaluations. However, sampling durations and air flow rates may be modified in the field based on site-specific conditions. For all air sampling, a sampling train consisting of 0.8 um, 25 mm MCE filter connected to a sampling pump will be used. The top cover from the cowl extension on the sampling cassette shall be removed ("open-face") and the cassette oriented face down.

The samples will be submitted to the laboratory for analysis. If the samples are not readable by transmission electron microscopy (TEM) after a direct preparation method, the samples may be used by applying an indirect sample preparation technique. *The laboratory must consult with BNSF/USEPA in order to select which is the most appropriate approach to follow*.

Pump Fault and Flow-Rate Error Procedures

Because the sampling cannot impede the progress of the rail maintenance activities, if there is a malfunction or other event that prevents a worker sample from being collected, that sample collection effort will be discontinued for that worker. For this reason, periodic checks to verify the maintenance workers' pump flow rates can not be implemented.

MET Station Data

Meteorological (MET) station data collection procedures are described in the Public Receptor SAP.

2.3 General Processes

2.3.1 Equipment Decontamination

Decontamination of air sampling pumps will be conducted as described in Section 3.0 of the Project-Specific Procedures, as presented in Appendix A of the Public Receptor SAP. Equipment used during activities will be decontaminated after each use as described in the HASP (see Appendix B of the Public Receptor SAP).

2.3.2 Sample Labeling and Identification

Sample index identification numbers will identify the samples collected during this study by having the following format:

BA-#####

where:

BA	=	Activity-based air sample collected from OU6 ROW
#####	=	A sequential number starting with 00001; sample identification information will be documented in the field logbook

2.3.3 Videotape Documentation

A videotape may be prepared to document a representative example of each activity including any special conditions or circumstances that arose during the activity, following Section 6 of the OU6 Project-Specific Procedures, and Project-Specific Procedure – 5: Photographic Documentation of Field Activities, as presented in Appendix A of the Public Receptor SAP. File names will be in the format:

RRABS_(W, T, or P)_MP####_MMDDYY, where:

RRABS	=	Railroad Activity Based Sampling
W	=	Rail maintenance worker
MP	=	Closest Mile Post
####	=	Mile Post number
MMDDYY	=	Month day year

All photographic documentation will be maintained in project files.

2.3.4 Field Logbooks

Field logbooks will be completed and managed as described in Section 4.0 of the Project-Specific Procedures, as presented in Appendix A of the Public Receptor SAP. The Project-Specific Procedure - 4: Field Logbook Content and Control, including project-specific modification is also provided in Appendix A of the Public Receptor SAP. Copies of all logbook entries will be provided to USEPA and BNSF within one month of collection. The information for this SAP will be collected in the same field logbooks used for the Public Receptor SAP.

2.3.5 Field Sample Data Sheets

Field Sample Data Sheets (FSDSs) for the ABS sampling will be completed and managed as described in Section 5.0 of the Project-Specific Procedures, as presented in Appendix A of the Public Receptor SAP.

Appendix D of the Public Receptor SAP contains copies of the specific FSDSs that will be used to record information for samples collected during the activities described in this SAP. Copies of FSDSs will be provided to USEPA and BNSF within one month of collection.

2.3.6 Photographic Documentation

Photographs will be collected, documented, and managed as described in Section 6.0 of the Project-Specific Procedures, as presented in Appendix A of the Public Receptor SAP. The Project-Specific Procedure - 5: Photographic Documentation of Field Activities is also provided in Appendix A of the Public Receptor SAP. Photographs will be used to document areas where outdoor activities are conducted. Photographs of each event will be compiled into one file, and file names will be in the format:

RRABS_(W, T, or P)_MP####_MMDDYY, where:

RRABS	=	Railroad Activity Based Sampling
W	=	Rail maintenance worker
MP	=	Closest Mile Post
####	=	Mile Post number
MMDDY	=	Month day year

2.3.7 GPS Point Collection

GPS location coordinates will be collected as described in Section 7.0 of the Project-Specific Procedures and in accordance with CDM-LIBBY-09, which are both provided in Appendix A of the Public Receptor SAP. As related to the activities described in the SAP, one set of coordinates will be collected from the approximate ROW MP boundaries for each activity area. These coordinates will also represent the GPS coordinates associated with the MET station.

2.3.8 Field Equipment Maintenance

Air sampling pump calibrations will be conducted and documented as described in Section 8.0 of the Project-Specific Procedures, as presented in Appendix A of the Public Receptor SAP. Field equipment maintenance will be conducted and documented as described in Section 9.0 of the Project-Specific Procedures and in accordance with the Project-Specific Procedure - 6: Control of Measurement and Test Equipment, which are both provided in Appendix A of the Public Receptor SAP.

2.3.9 Handling IDW

IDW will be managed as described in Section 10.0 of the Project-Specific Procedures, as presented in Appendix A of the Public Receptor SAP. The Project-Specific Procedure - 3: Guide to Handling of IDW is also provided in Appendix A of the Public Receptor SAP.

2.3.10 Field Sample Custody and Documentation

Field Sample Custody and Documentation will follow the requirements described in Section 11.0 of the Project-Specific Procedures, as presented in Appendix A of the Public Receptor SAP. The Project-Specific Procedure - 1: Sample Custody is also provided in Appendix A of the Public Receptor SAP. Copies of all chain-of-custody (COCs) forms will be provided to USEPA within one month of collection.

2.3.11 Sample Packaging and Shipping

Sample packaging and shipping will follow the requirements described in Section 12.0 of the Project-Specific Procedures, which is presented in Appendix A of the Public Receptor SAP. The Project-Specific Procedure -

2: Packaging and Shipping of Environmental Samples, including a project-specific modification is also provided in Appendix A of the Public Receptor SAP.

2.3.12 Modification Forms

All deviations will be documented and recorded according to the requirements described in Section 13.0 of the Project-Specific Procedures, as presented in Appendix A of the Public Receptor SAP. A copy of the modification form is provided in Appendix E of the Public Receptor SAP.

2.4 Quality Assurance/Quality Control (QA/QC) Activities

The QA/QC actions required for each process described in this SAP will follow the requirements described in the Section 15.0 of the Project-Specific Procedures, which is provided in Appendix A of the Public Receptor SAP.

Collection of QA/QC Field Samples

QA/QC samples will be collected according to the procedures described in the Project-Specific Procedures. **Table 2-2** summarizes the QA/QC sample collection and analysis frequencies for the outdoor ABS investigation.

3.0 Laboratory Analysis and Requirements

All laboratories that analyze samples collected as part of this project must participate in and have satisfied the certification requirements in the last two proficiency examinations from the National Institute of Standards and Technology/National Voluntary Laboratory Accreditation Program (NVLAP). The laboratory must also analyze performance evaluation samples when requested. These analyses must be performed to confirm laboratory capabilities before any samples are submitted to the laboratory and may be subsequently submitted at regular intervals. In addition, the laboratory must participate in the laboratory training program developed by the Libby laboratory team. **Appendix B** of this report provides the Analytical Requirements Summary Form.

3.1 Analytical Methods

3.1.1 ABS Air

All outdoor air samples will be submitted to a subcontracted laboratory for analysis using the International Organization for Standardization (ISO) TEM method 10312, also known as ISO 10312:1995(E) (CDM 2003a), with all applicable project specific modifications (CDM 2003b). These and other project-specific modifications are included in Appendix A of the Public Receptor SAP. All asbestos structures (including not only Libby amphibole but all other asbestos types as well) that have appropriate diffraction patterns and EDS spectra, and having length $\geq$ 0.5 um and an aspect ratio ≥ 3:1 will be recorded on the Libby site-specific laboratory data sheets and electronic deliverables.

The target analytical sensitivity for all ABS air samples is 0.001 cubic centimeters^{-1} (cc^{-1}) (see Section 3.7.2). Field blanks and lot blanks, will be analyzed by counting an area of 0.1 square millimeters (mm^2) (K. Hernandez, USEPA, personal communication).

3.1.1.1 Stopping Rules

For field samples, the initial stopping rules are as follows:

Count the sample until one of the following is achieved:

- The target analytical sensitivity is achieved
- 50 LA structures are observed
- An area of 0.5 mm^2 of filter has been examined

When one of these goals is achieved, complete the final grid opening and stop. These stopping rules may be revised as data become available on the levels of LA and dust that are collected in the field samples.

For field blanks and lot blanks, examine a filter area of 0.1 mm^2 and stop.

3.1.1.2 Quality Control (QC) Samples

As described in the latest version of laboratory modification LB-000029, the frequency for laboratory-based quality control (QC) samples for TEM analysis is:

- Lab blank = 4 percent
- Recount same = 1 percent
- Recount different = 2.5 percent

- Re-preparation = 1 percent
- Verified analysis = 1 percent
- Inter-laboratory = 0.5 percent

3.1.2 IH Air Samples

All IH air samples will be submitted within 24 hours of collection to a subcontracted laboratory for analysis by an American Industrial Hygiene Association (AIHA)-certified analyst using National Institute for Occupational Safety and Health (NIOSH) method 7400 for phase contrast light microscopy (PCM) in accordance with BNSF's Data Collection and Management Policies and Procedures (presented in **Appendix A** of this report). If significant structures are present on the air filter or if the air filter is overloaded, analysis of the air sample will be conducted using NIOSH TEM method 7402, which is outlined in the Asbestos Hazard Emergency Response Act (AHERA) and presented in BNSF's Data Collection and Management Policies and Procedures (**Appendix A** of this report). Therefore, the contracted laboratory must participate in AIHA's Proficiency Analytical Testing (PAT) program and/or a National Voluntary Laboratory Accreditation Program (NVLAP). In addition, completion of the NIOSH course for sampling and evaluating airborne asbestos dust or an equivalent course is required for all individuals who perform asbestos analysis.

3.1.3 Sample Archival

All air samples will be submitted to a project laboratory for analysis. Once analyzed, all samples will be stored (archived) at the laboratory under COC until further notice.

3.2 Holding Times

No preservation requirements or holding times are established for air samples collected for asbestos analysis.

3.3 Laboratory Custody Procedures and Documentation

Laboratory custody procedures and documentation will be completed as required by the specifications detailed in Section 16.0 of the Project-Specific Procedures, as presented in Appendix A of the Public Receptor SAP.

3.4 Documentation and Records

Laboratory documentation and records will be completed as required by the specifications detailed in Section 17.0 of the Project-Specific Procedures, as presented in Appendix A of the Public Receptor SAP.

3.5 Data Management

Sample result data for IH air samples will be delivered to BNSF and copies will be maintained on file at the BNSF industrial hygienists' office.

Sample result data for ABS air samples will be delivered to BNSF, USEPA, the Volpe Center, and CDM's Cambridge office both in hard copy and as an electronic data deliverable (EDD) in the most recent project-specific format. Electronic copies of all project deliverables, including graphics, will be filed by project number. Electronic files will be routinely backed up and archived according to individual laboratory processes.

Both BNSF and USEPA will maintain a project database for the information collected under this SAP.

All results, field data sheet information, and survey forms will be maintained in the Libby project database managed by the Volpe Center under the oversight of the Volpe Center database management team. BNSF will maintain a database for the work conducted for OU6.

4.0 Assessment and Oversight

Assessments and oversight reports to management are necessary to ensure that procedures are followed as required and that deviations from procedures are documented. These reports also serve to keep management current on field activities. Assessment, oversight reports, and response actions are discussed below.

4.1 Assessments

Performance assessments are quantitative checks on the quality of a measurement system and are appropriate to analytical work. Performance assessments for the laboratories may be accomplished by submitting reference material as blind reference (or performance evaluation) samples. These assessment samples have known concentrations of LA that are submitted to the laboratories without informing the laboratories that they are performance evaluation samples. Laboratory audits may be conducted upon request from the USEPA Team Leader (TL).

System assessments are qualitative reviews of different aspects of project work to check on the use of appropriate QC measures and the functioning of the quality assurance (QA) system. Project assessments will be performed under the direction of the contractor QA managers.

4.2 Response Actions

Response actions will be implemented on a case-by-case basis to correct quality problems. Minor response actions taken in the field to immediately correct a quality problem will be documented in the applicable field logbook and a verbal report will be provided to the BNSF Project Manager (PM). For verbal reports, the BNSF PM will complete a communication log to document the response actions were relayed to him/her. Major response actions taken in the field will be approved by the BNSF PM and USEPA TL, prior to implementation of the change. Major response actions are those that may affect the quality or objective of the investigation. Quality problems that cannot be corrected quickly through routine procedures may require implementation of a corrective action request.

All formal response actions will be submitted to either BNSF's contractor's QA manager and/or project QA coordinator for review and issuance. The PM or local QA coordinator will notify the QA manager when quality problems arise that may require a formal response action.

In addition, when modifications to this specific SAP are required, either for field or laboratory activities, a Field Change Order (FCO) Form (Appendix C of the Public Receptor SAP) and a Libby Asbestos Project Record of Modification Form (Appendix E of the Public Receptor SAP) must be completed.

4.3 Reports to Management

QA reports will be provided to management whenever quality problems are encountered. Field staff will note any quality problems on field data sheets, or in field logbooks. BNSF will inform the USEPA's project QA coordinator upon encountering quality issues that cannot be immediately corrected. Weekly reports and change request forms are not required for this work assignment. Monthly QA reports will be submitted to USEPA's QA manager by the BNSF QA coordinator.

Topics to be summarized regularly may include but not be limited to:

- Document technical and QA reviews that have been conducted;
- Activities and general program status;
- Project meetings;

- Corrective action activities;
- Any unresolved problem; and
- Any significant QA/QC problems not included above.

5.0 Data Validation and Usability

Laboratory results for ABS samples will be reviewed for compliance with project objectives. Data validation and evaluation are discussed in Sections 5.1 and 5.2, respectively.

5.1 Data Review, Validation, and Verification Requirements

ABS air data review, validation, and verification will be performed for important investigative samples as described in Section 18.0 of the OU6 QAPP, provided in Appendix A of the Public Receptor SAP. Data validation, review, and verifications must be performed on sample results before distribution to the public for review. Requirements for the frequency of data review are initially set at 10 percent. This initial rate may be revised as initial samples are analyzed and results evaluated.

Data validation consists of examining the sample data package(s) against pre-determined standardized requirements. The validator may examine, as appropriate, the reported results, QC summaries, case narratives, COC information, raw data, initial and continuing instrument calibration, and other reported information to determine the accuracy and completeness of the data package. During this process, the validator will verify that the analytical methodologies were followed and QC requirements were met. The validator may recalculate selected analytical results to verify the accuracy of the reported information. Analytical results will then be qualified as necessary.

Data verification includes checking that results have been transferred correctly from FSDS forms and laboratory bench sheets to the laboratory report and to the EDD. Data verification for this project is performed in part as a function of built-in quality control checks in the Libby project database when data is uploaded, and is also performed manually in accordance with SOP EPA-LIBBY-09. However, the sample coordinator will notify the laboratories and the project database manager of any discrepancies found during data usage.

5.2 Reconciliation with Data Quality Objectives

Once ABS data have been generated, USEPA and BNSF will evaluate the data to determine if data quality objectives (DQOs) were achieved. This achievement will be discussed in a report to be submitted to USEPA, including the data and any deviations to this SAP. It is currently envisioned that the data will be submitted as part of a Preliminary Conceptual Site Model Report, which will be used to collect and evaluate existing data, develop a conceptual site model for OU6, and identify data gaps that will be addressed during the RI/FS process. BNSF will maintain a database for the work conducted at OU6. Sample data will also be maintained in the USEPA project database. Laboratory QC sample data will be stored in hard and electronic copy.

6.0 Project Schedule

The rail maintenance activities and associated ABS sampling will be conducted from September 17 to 25, 2008. It is anticipated that results from this round of sampling will be available for tabulation in late October 2008.

7.0 References

29 CFR 1910.1001. Code of Federal Regulation, OSHA Standards for Asbestos.

Amandus HE, Wheeler R. 1987. The Morbidity and Mortality of Vermiculite Miners and Millers Exposed to Tremolite-Actinolite: Part II. Mortality. Am. J. Ind. Med. 11:15-26.

CDM. 2003a. Libby Asbestos Project, Analytical Guidance Documents, Volume 1, Section 3. August. *International Organization for Standardization (ISO), Ambient air – Determination of asbestos fibers – Direct-transfer transmission electron microscopy method, ISO 10312:1995(E).*

CDM. 2003b. Libby Asbestos Project, Modification to Laboratory Activities with ongoing updates. June.

CDM. 2007. Data Summary Report – Operable Unit 6 – BNSF Railyard, Tracks and Right-of-Way. Draft Final, Revision 1. December 21, 2007.

Haas CN, Rose JB, Gerba CP. 1999. Quantitative Microbial Risk Assessment. John Wiley and Sons, New York.

IRIS. 2008. Integrated Risk Information System. On-line database of toxicity data maintained by the U.S Environmental Protection Agency. http://www.epa.gov/iriswebp/iris/index.html

McDonald JC, McDonald AD, Armstrong B, Sebastien P. 1986. Cohort study of mortality of vermiculite miners exposed to tremolite. Brit. J. Ind. Med. 43:436-444.

McDonald JC, Harris J, Armstrong B. 2004. Mortality in a cohort of vermiculite miners exposed to fibrous Amphibole in Libby, Montana. Occup. Environ. Med. 61:363-366.

Peipins LA, Lewin M, Campolucci S, Lybarger JA, Miller A, Middleton D, et al. 2003. Radiographic abnormalities and exposure to asbestos-contaminated vermiculite in the community of Libby, Montana, USA. Environ. Health Perspect. 111:1753-1759.

USEPA. 1992. Supplemental Guidance to RAGS: Calculating the Concentration Term, 9285.7-081.

USEPA. 2001. EPA Requirements for Quality Assurance Project Plans. EPA QA/R-5. U.S. Environmental Protection Agency, Office of Environmental Information. EPA/240/B-01/003. March 2001.

USEPA. 2006. Guidance on Systematic Planning Using the Data Quality Objectives Process – EPA QA/G4. U.S. Environmental Protection Agency, Office of Environmental Information. EPA/240/B-06/001. February 2006.

USEPA. 2007a. Sampling and Analysis Plan for Indoor Air, OU4, Libby, Montana, Superfund Site. April 1, 2007.

USEPA 2007b. Standard Operating Procedures # 2084. Activity-Based Air Sampling for Asbestos. May 10, 2007.

Table 1-1 Description of Rail Maintenance Activities For Worker Receptors
Rail Maintenance Worker Receptor Activity-Based Sampling and Analysis Plan
Operable Unit 6, Libby, Montana Superfund Site, October, 2008

MP: 1312, 1314	General Maintenance Activity: Curve Replacement [a]			Worker Sampling Activity		
Time	Description	Soil Disturbance Potential	Duration (hrs)	# ABS Samplers	Approx. ABS Duration (hrs)	ABS Locations
7:00 AM	Safety Meeting	Low	0.5	NA		
7:30 AM	Track Material Inspection	Low	0.5	NA		
8:00 AM	Steel Gang: Rail Replacement	Medium	4-8	2 [b]	4-8	work area
8:30 AM						
9:00 AM						
9:30 AM						
10:00 AM						
10:30 AM						
11:00 AM						
11:30 AM						
12:00 PM						
12:30 PM						
1:00 PM						
1:30 PM						
2:00 PM						
2:30 PM						
3:00 PM						
3:30 PM						
4:00 PM	Inspection of Finished Trackwork	Low	1	NA		
4:30 PM						

Notes:
NA = not applicable
Typical track work length = 1/4 to 1/2 mile

[a] Daily maintenance activities vary based on the length of track requiring maintenance. Therefore, workdays may range from 4 to 8 hours per day. A field log of maintenance activities, including schedules and specific activities will be maintained by EMR field supervisor (or similar).

[b] Chris Weis recommends one air monitor for each job activity per day. Due to technical problems, EPA recommends collecting a backup monitor on another worker (a total of two monitors).

Table 2-1 Summary of Onsite Rail Worker ABS Design
Rail Maintenance Worker Receptor Activity-Based Sampling and Analysis Plan
Operable Unit 6, Libby, Montana Superfund Site, October, 2008

Item	Description
Conceptual Model	See Table 1-1
Representativeness	Represents personal air during rail maintenance activities
Exposure parameters assumed in calculation of target sensitivity	ET = 4-8 hrs/event Flow rate = 5 L/min Volume Air Sampled = 1,200 L (1,200,000 cc)
Analytical Requirements	Method = ISO 10312 with all applicable lab mods Sensitivity = 0.001 cc^{-1} Stopping rules: a) Target S achieved (approx 32 GO/0.32 mm^2 expected) b) Max LA structures observed = 50 c) An area of 0.5 mm^2 of filter has been examined
Initial number of samples (a)	1 per worker × 2 workers per day = 2

(a) The number of samples needed for risk assessment and risk management depends on the inter-sample variability and how close the data are to a decision threshold. This number of samples is expected to provide sufficient information to determine if additional samples are needed, and if so, how many.

GO - Grid Opening
LA - Libby Amphibole.

Table 2-2 Summary of Field QC Samples by Medium
Rail Maintenance Worker Receptor Activity-Based Sampling and Analysis Plan
Operable Unit 6, Libby, Montana Superfund Site, October, 2008

Media	Sample Type	Minimum Collection Frequency		Minimum Analysis Frequency	Acceptance Criteria	Acceptance Criteria Failure Action
Air	Lot Blank	1 per 50 cassettes	2%	1 per 50 cassettes	ND for all asbestos	Rejection of all cassettes in lot
	Field Blank	1 per day		10% of total collected per week	ND for all asbestos fibers	Analysis of additional field blanks to determine source of potential cross-contamination, qualification of sample results, evaluation of field sample handling procedures
	Co-located	1 per 20 samples	5%	100%	<5% statistically significant difference	Evaluation of sample collection techniques

Notes:
QC - quality control
ND - nondetect
COC - chain of custody

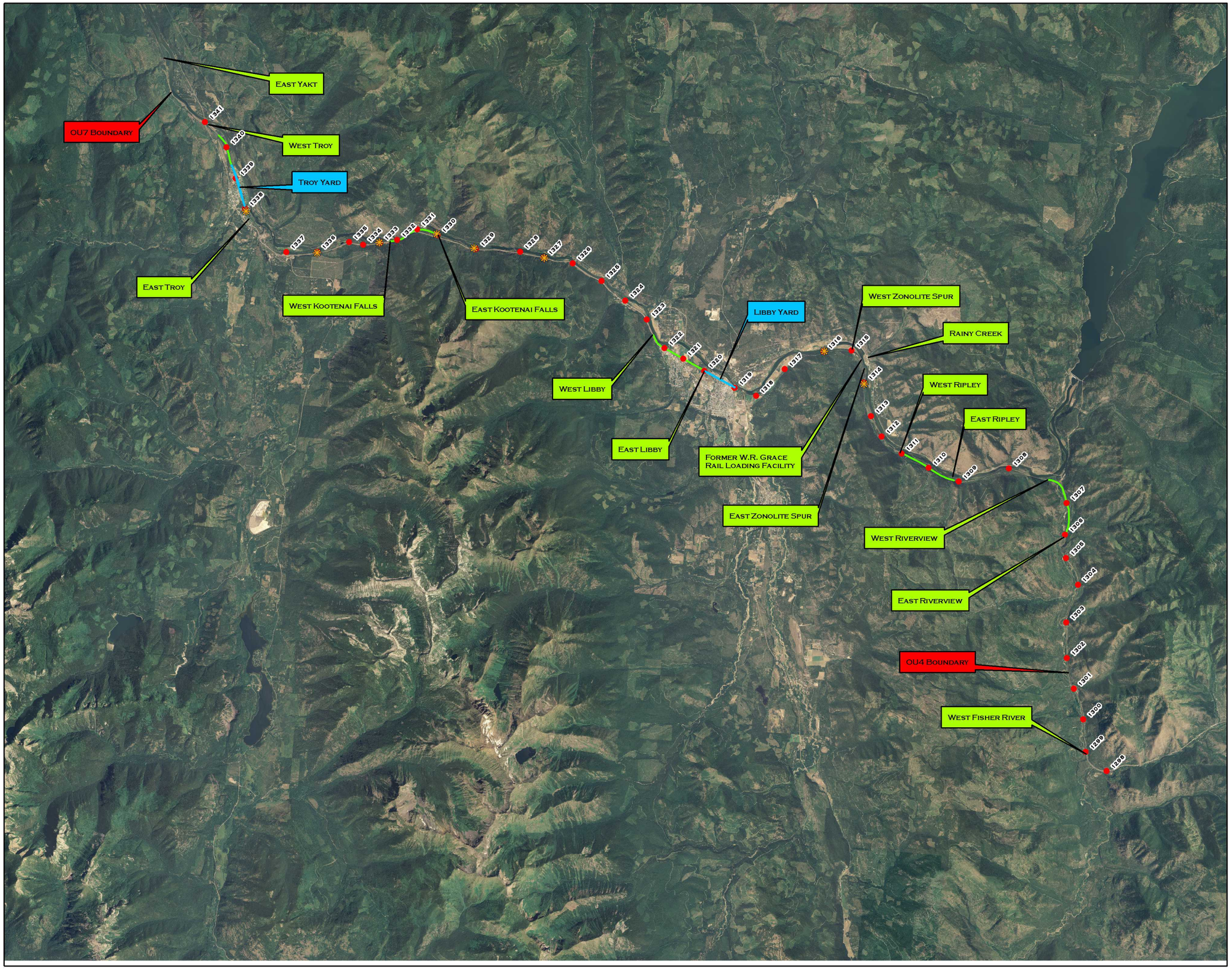


Figure 1-1
Scheduled Rail Maintenance Work Sites

BNSF Kootenai River Sub

Legend

- Steel Gang Work Sites
- BNSF Yard
- Approximate Milepost Locations
- Rail Sidings

0 7,500 15,000 30,000

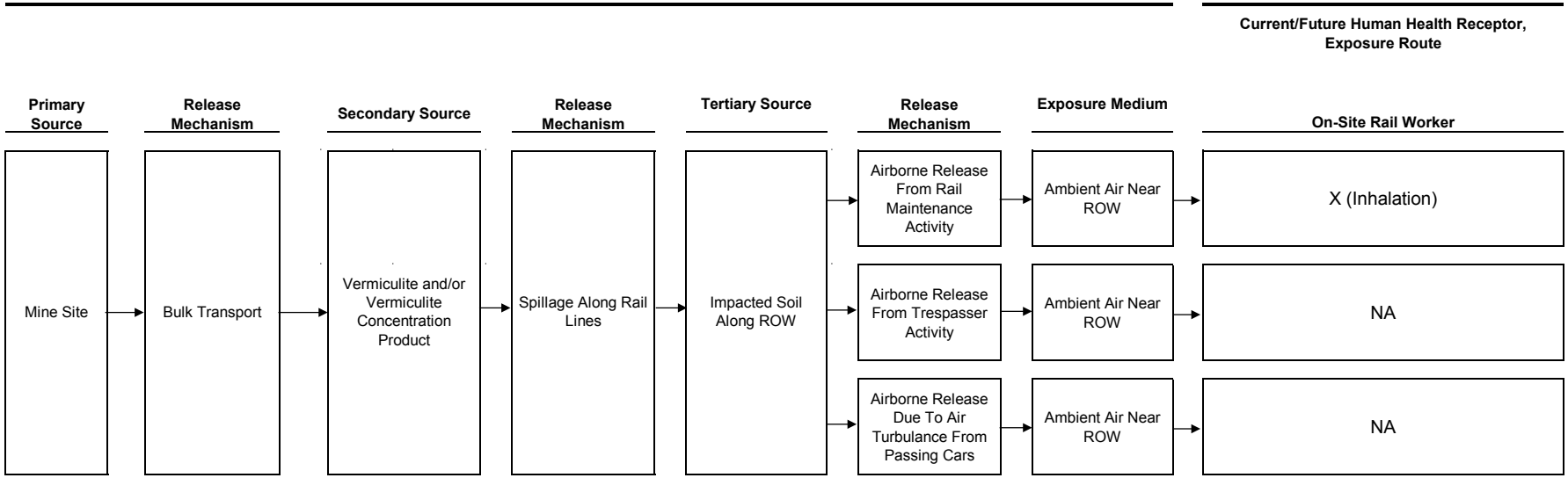
Scale In Feet

0 1 2 4

Scale In Miles

EMR INCORPORATED

Figure 1-2 Refined Conceptual Site Model For Worker Receptors
Rail Maintenance Worker Receptor Activity-Based Sampling and Analysis Plan
Operable Unit 6, Libby, Montana Superfund Site, October, 2008



Legend:

X	Potentially Complete and Significant Exposure Pathway - to be quantitatively evaluated in the risk assessment

ROW = BNSF Right of Way

Appendix A

BNSF Data Collection and Management Policies and Procedures

Data Collection and Management Policies and Procedures

for BNSF Industrial Hygiene Projects

Revision 2.1, 10/10/2005

Contents

1. Purpose and Scope

Burlington Northern Santa Fe Railroad (BNSF) recognizes the importance of industrial hygiene data in evaluating and controlling potential exposures to employees. Industrial hygiene data is used on a frequent basis to assess employee exposures and serves as a key decision tool in determining the effectiveness of past and current efforts, as well as strongly influencing future directions for the industrial hygiene group. This data is frequently requested for support in litigation, and must be of the highest quality and usability in order to fully demonstrate BNSF's commitment to a safe working environment for its employees. Finally, BNSF recognizes the significant resources in manpower and dollars required to gather and interpret this data, and believes the potential benefits of this investment should be maximized to the greatest extent practical.

This policy and procedure document provides requirements and guidelines for the collection, quality assurance and management of field sampling data, associated supporting documentation, laboratory analysis data, reports and correspondence associated with industrial hygiene projects. It describes in detail the requirements for the use of standardized forms and methods for field data collection, use of online and other computer-based tools to facilitate access to and analysis of data, requirements for quality review of industrial hygiene data, and workflow procedures that will help ensure data files are complete, accessible and accurate. The program also provides standard sampling profiles and methodologies required for the most commonly encountered industrial hygiene sampling projects.

The BNSF Industrial Hygiene Group believes the requirements and guidelines provided in this document will ensure the highest level of quality for its IH data, reduce the level of effort and complexity required to bring a project to its endpoint, and ensure future usability and accessibility of the information for a variety of purposes.

2. Documentation Definitions and Requirements

This document discusses the use of standard forms and procedures for the collection and management of industrial hygiene data. It also describes the organization of data into discrete elements to allow better management and quality control of the various pieces of documentation associated with an industrial hygiene project. This section provides definitions and examples of the various documentation elements and processes.

2.1 Terms and Definitions

- **Project:** A project is any effort with definable start and end dates intended to evaluate employee exposures to chemical, physical or biological agents. Projects may include any or all of the project documentation discussed in the following text.
- **Project Documentation:** A project may include many different types of documents. Whether or not a specific piece of documentation is required depends on the nature of the project. However, all documentation associated with a project should be placed in one of the following categories:
    - *Consultant or Other Third Party Reports:* Reports written by consultants, contractors or other third parties specifically reporting sampling results and/or discussing specific employee exposures.
    - *Correspondence:* Includes letters, emails, phone logs or other records of communications and discussion between parties involved in or having an interest in a specific project.

- *Employee Notification Letters:* Official letters sent to BNSF employees, informing them of the results of sampling efforts in which they participated. Certified mail receipts for these letters are also included in this category.
- Field Data Sheets: Sample collection and instrument calibration records, documenting the sample collection process.
- Field Notes: Notes, observations and comments recorded during field activities, clarifying, explaining and highlighting relevant events and conditions.
- *Invoices and Financial Records:* Any records of expenses incurred during planning, execution and finalization of a project.
- *Laboratory Chain of Custody Records:* Critical documents used to specify the samples sent to a laboratory for analysis, the type of analyses requested, and for tracking possession of samples.
- *Laboratory Analysis Reports:* Critical documents used to report the levels of contaminants measured during sampling events.
- *Photographs/Videos:* Images recorded digitally or otherwise that illustrate the exposure conditions, work environment and project activities.
- *Printouts from Dosimeters and Direct-Reading Instruments:* Hard copy or electronic files produced from noise dosimeters and other direct-reading instruments. Many modern instruments are capable of recording and logging large volumes of detailed data, which can be valuable in evaluating rapidly changing environments.
- *Reference Materials:* Copies of MSDS, schedules, articles or other documentation which provide relevant information regarding the execution or interpretation of a project.
- *Sample Data Packages:* Field data forms used to document sample collection and field observation. This documentation is discussed in detail in other sections of this document.
- *Weather Reports:* Printouts or electronic copies of weather reports that may be relevant to interpreting the results of a particular project.
- *Data Entry:* Generic term used for any administrative or professional support group assigned to assist the IH group in entering raw data into the online database.
- File Support: File support is the generic term used for any administrative support personnel or groups assigned to assist the IH group in document tracking and filing.
- *Quality Assurance (QA) Review:* Review of hardcopy and electronic data to ensure completeness and accuracy.
- *Document Workflow:* The steps followed in collecting, reviewing, inputting and filing of industrial hygiene project records.
- *Data Packet:* Organized collection of project documentation that represents all hard and electronic files associated with a project.

2.2 Standard Forms

In order to ensure that industrial hygiene data is collected in a uniform and consistent manner, BNSF requires the use of certain standard forms. The use of these forms is important, as it not only ensures consistency, but also greatly improves the efficiency and reliability of data entry into the online database. The standard IH Data Collection and tracking forms used by BNSF are shown in Appendix A., Standard Forms. Explanations of these forms are presented in the following paragraphs of this section.

Industrial Hygiene Project File
This form is used to provide basic project description information used at various points during the document tracking and routing process. It also serves as a convenient checklist and quality assurance tool. The tracking form is used by the IH to organize and track project documentation,

by Data Entry to standardize input and scanning of project information, and by File Support to ensure that the complete document set for a project has been placed in the hard file.

Field Collection Record for IH Samples
The Field Collection Record consists of six () parts.

Form 1: Project Profile and Notes allows the IH to record the project identifier, collection date, collector, job setting, business unit, environment, building and analytical profile for a sample set. It also allows the IH to record work equipment items, task information, exposure modifiers, personal protective equipment and field notes common to all samples. This reduces the redundancy of entering this information for each individual sample, but still allows recording of work environment descriptors with a high level of detail. The items entered on this form (i.e. job setting, facility, analytical profile, etc.) should be the same as stored in the online database. Copies of the allowed values for each form field may be viewed and printed from the online database.

Form 2: Field Sample Index is intended as field data sheet for recording basic calibration and sample information. It allows multiple samples (air, noise, bulk, etc.) to be recorded on a single page. It allows the user to handle less paper while collecting sample information. It also serves as a calibration log. Additional task, equipment and exposure modifier information for individual samples should be recorded on *Form 3: Individual Sample Collection Record*, or, for noise samples on *Form 4: Noise Dosimetry Supplementary Record*.

Form 5: Time and Motion Tracking Form is an optional form that can be used to record detailed time and motion for various tasks. This form can modified with specific tasks of interest for a given project, and the form will allow the user to easily record start and stop times for each designated task of interest. The total time spent for each task is added to the subtotals boxes at the bottom of the page, then transferred to the task information boxes on *Form 3* or *Form 4*, as appropriate.

Form 6: DRI Field Measurement Form allows the IH to record multiple discrete measurements (grab samples) such as readings from colorimetric tubes, electrochemical detectors, etc.

Together, these forms allow the IH to collect detailed data in a consistent manner which is easily interpreted on subsequent review. The form collection also makes data entry and quality assurance faster and more efficient, by creating a uniform framework for data collection and reporting.

3. Data Quality Assurance

Ensuring the quality of collected data is of critical importance. The use of the standard forms described in Section 2.2 allow the IH to clearly understand and record key data elements necessary to interpret and defend the data collection procedures ad processes associated with a project. Therefore, correct and consistent use of the sample collection forms will help ensure that data quality remains at acceptably high levels.

3.1 Review Prior to Data Entry

It is also important that the individual IH review the data collection forms and project documentation at certain key points. The first review should be performed before the project data is submitted for data entry. This is particularly critical when working with contractors or other third parties who may have limited familiarity with BNSF's forms and procedures. The responsible IH must ensure that all necessary forms are present, legible and complete. Laboratory data should be checked and verified as necessary. The responsible IH must also ensure that all appropriate supporting documentation is present and complete, and has been adequately identified and

organized. Otherwise, Data Entry may return the project, or input an incomplete, confusing or inaccurate record.

3.2 Review After Data Entry

The responsible IH must review the data entered into the online database after Data Entry is complete. The IH should verify that data has been transferred accurately from the field collection records, and that all documentation submitted has been scanned and uploaded correctly. If the IH had additional electronic files (images, spreadsheets, etc.) these should also be uploaded to the online database to complete the project record.

3.3 Pre-Filing Review

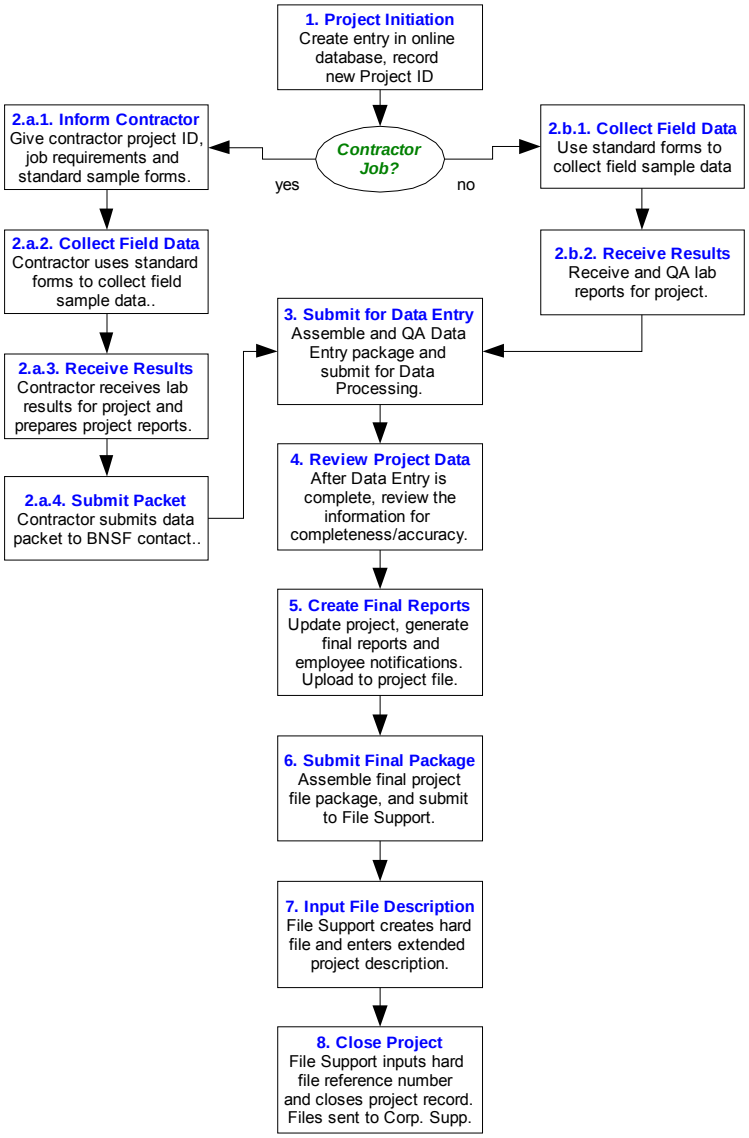
A final review of the project documentation should be performed by File Support prior to submitting the project files for storage and closing the project in the online database. This review should ensure that all specified documentation is present and complete, that a file number has been successfully assigned to the project, that the file number has been recorded in online database's project record, and the project file closed in the online database.

4. Documentation Workflow

The flow of project documentation should be handled as consistently as practical. Establishing a routine workflow procedure makes this process habitual, and will improve the efficiency of managing project documentation. Figure 1 provides a basic diagram of the documentation workflow. The remainder of this section provides additional detail on the steps identified in Figure 1.

Figure 1.

Document Management Workflow



4.1. Project Initiation

Upon initiating a project, the responsible IH should create a new project record in the online database, identifying the project name, facilities studied and tentative start and stop dates. The IH should also record the key personnel involved in the project, along with brief descriptions of their respective roles. This will generate a project identifier (a number) which can be used for reference purposes on all subsequent project records.

4.2. Collecting Data

During project work, field data is collected on the appropriate forms. Copies of laboratory chain of custody records are retained, along with any reference materials, correspondence, photos or other documents generated during the initial phases of the project. Retain hard or electronic copies of laboratory analysis reports.

If contractors are involved in the work, it is very important to inform them thoroughly of BNSF's data collection procedures and requirements. They must be provided with the project ID number and any reference lists necessary to allow them to complete the data collection forms properly. The responsible IH should review the forms and data collection procedures and requirements with the contractor, to ensure the requirements are understood and accepted by all parties.

4.3 Submit for Data Entry

The responsible IH should assemble all the project documentation, organizing and identifying each type of document. Field data forms should be reviewed and amended as necessary, and the project overall checked for legibility, organization and completeness. The IH should then complete the *Industrial Hygiene File Tracking Form*, and submit a copy of the complete project file to Data Entry for input into the online database. Data Entry will complete data input as well as scanning and upload of hard copy files/photographs. The responsible IH should upload any electronic project files in his or her possession. Data Entry will email or call the responsible IH to inform them when data entry is complete. Data Entry will retain the submitted document copies for ten days, then destroy them.

4.4 Review Project Data

After Data Entry is complete, the responsible IH should review the input data and the scanned documentation using the online database, in order to ensure accuracy and completeness. The responsible IH can make minor corrections directly, or contact Data Entry for more extensive corrections.

4.5 Create Final Reports and Submit Final Package

After completing the review of the input and scanned data, the responsible IH should create the final entries in the project narrative in the online project record and create any final reports and employee notifications. In most cases, the reports generated by the online database can suffice as the final reports and notifications. If using these online reports, the IH should print a copy of the reports and notifications as Adobe Acrobat files and upload them to the project document library. Print a copy of each electronic document for inclusion in the project hard file. Submit the final reports along with the rest of the project documentation for File Support for filing.

4.6 Input File Description

File Support will review received files for legibility, organization and completeness. File support will create a record with an extended file description in the IRIMS database describing the project, and giving it an IRIMS file number.

4.7 Close Project and Submit to Storage

File Support will enter the newly generated IRIMS number into the project record in the online database for cross-referencing, then close the project record. File Support will then forward the project documentation file, along with appropriate routing instructions, to Corporate Support for final document storage.

5. Standard Analytical Profiles

BNSF has a reasonably stable work environment, in which the exposure potential for the majority of workers has been well-characterized. Because of this, it is possible to create standard analytical profiles which can be used to evaluate employee exposures. While not intended to address every possible exposure scenario, the standard profiles can be used in the majority of projects to ensure consistency and thoroughness of exposure assessment activities.

5.1 Standard Analytical Profile List

Table 1. lists the current set of standard analytical profiles in use at BNSF. These profiles are also available in the online database. Additional profiles may also exist in the database. Check the database prior to sampling for situations or jobs not described in Table 1. Each of the analytical profiles includes a reference to BNSF's standard sampling methodologies. The standard methodologies describe the protocols, procedures, media and analytical method for the chemicals listed in the analytical profile.

Table 1. Standard Analytical Profile List

Profile Name	Recommended Analytes	Sampling Method (Section 6.1, 6.2)
Acrolein (TWA/STEL)	Acrolein	Acrolein
Alcohols (TWA/STEL)	n-Propyl Alcohol Ethyl Alcohol n-Butyl Alcohol t-Butyl Alcohol Isopropyl alcohol	Alcohol Scan
Aldehyde Scan (TWA)	Acetaldehyde Crotonaldehyde Formaldehyde Glutaraldehyde Propanaldehyde	Aldehyde Scan (5)
Ammonia (Grab)	Ammonia	Drager CMS (DRI)
Ammonia (STEL/TWA)	Ammonia	Ammonia (DRI) AIM Commander
Asbestos in Air (TWA/Excursion)	Asbestos, all forms	1. Asbestos in Air (TEM)
Bisphenol-A (TWA)	Bisphenol-A	Bisphenol-A
BTEX (TWA/STEL)	Benzene Toluene Ethyl-benzene Xylene	BTEX
Butadiene	Butadiene	Butadiene (Diesel Organic)
Carbon Monoxide (TWA)	Carbon monoxide	Carbon Monoxide (DRI) AIM Commander
Carbon Monoxide by Colorimetric (Grab)	Carbon Monoxide	1. Drager CMS (DRI) 2. Sensidyne Tube (DRI)

Table 1. Standard Analytical Profile List

Profile Name	Recommended Analytes	Sampling Method (Section 6.1, 6.2)
Carbon, Elemental (TWA)	Elemental carbon	Diesel Particulates as Elemental Carbon
Chlorinated Solvents (TWA/STEL)	Chlorobenzene Chloroform 1,1 – Dichloroethane 1,2-Dichloroethylene Hexachloroethane Tetrachloroethylene Trichloroethane 1,1,1-Trichloroethane 1,1,2-Trichloroethane	Chlorinated Solvents Scan
Chlorine (Ceiling) by Colorimetric	Chlorine	1. Drager CMS (DRI) 2. Sensidyne Tube (DRI)
Chlorine (Ceiling/PEL) by DRI	Chlorine	1. Chlorine (DRI) AIM Commander
Chromium, Hexavalent (Cr^6)	Hexavalent chrome	Chromium, Hexavalent (Cr^6)
Diesel Organics (TWA/STEL)	Total hydrocarbons, as n-hexane Naphthalene BTEX Kerosene Acetone MEK	Diesel Organic Scan
Epichlorohydrin (TWA)	Epichlorohydrin	Epichlorohydrin
Hydrogen Sulfide by Colorimetric (Ceiling/Peak)	Hydrogen sulfide	1. Hydrogen sulfide (DRI), Drager CMS 2. Hydrogen sulfide (DRI), Sensidyne Tubes
Hydrogen Sulfide by DRI (TWA/STEL)	Hydrogen sulfide	Hydrogen sulfide (DRI), AIM Commander
Isocyanates (TWA)	Hexamethylene diisocyanate (HDI) Methylene bisphenyl isocyanate (MDI) 2,4 Toluene diisocyanate (2,4-TDI) 2,6 Toluene diisocyanate (2,6-TDI)	Isocyanate Scan
Lead (Bulk)	Lead	Lead (Bulk solids)
Lead (Wipe samples)	Lead	Lead (Wipe Samples)
Methanol (TWA/STEL)	Methanol (methyl alcohol)	Methyl Alcohol
Methylene Chloride (TWA/STEL)	Methylene chloride	Methylene chloride
Nitrogen Dioxide (Ceiling) by Colorimetric	Nitrogen dioxide	Nitrogen Dioxide (DRI), Drager CMS Nitrogen Dioxide (DRI), Sensidyne Tubes
Nitrogen Dioxide (STEL/Ceiling)	Nitrogen dioxide	Nitrogen Dioxide (DRI), AIM Commander
Oxides of Nitrogen (TWA)	Nitric oxide* (lab method only) Nitrogen dioxide	1. Oxides of Nitrogen 2. Nitrogen Dioxide (DRI), AIM Commander *(NO2 only)
PAH (TWA)	Anthracene Benzo(a)pyrene Chrysene Phenanthrene Pyrene	PNA Scan (Polynuclear Aromatic Hydrocarbons)
PCB (TWA)	Polychlorobiphenyls (PCBs)	Polychlorobiphenyls (PCBs)
Respirable Dust, with or without Silica (TWA)	Respirable Dust	1. Respirable Dust (without Silica) 2. Respirable Dust (with Silica)
Sulfur Dioxide (TWA)	Sulfur dioxide	1. Sulfur Dioxide (SO2) 2. Sulfur Dioxide (SO2), (DRI), AIM Commander
Total Dust, with or without Silica (TWA)	Total Dust	1. Total Dust (without Silica) 2. Total Dust (with Silica)

Table 1. Standard Analytical Profile List

Profile Name	Recommended Analytes	Sampling Method (Section 6.1, 6.2)
Welding Fumes (TWA)	Antimony Beryllium Cadmium Chromium Cobalt Copper Iron Lead Manganese Molybdenum Nickel Vanadium Zinc Welding Fume	Welding Fumes (13 metal scan) **Note:** *Hexavalent Chromium requires separate analysis*

5.2 Recommended Analytical Profile Combinations for Common Exposure Monitoring Situations

Table 2 shows the recommended analytical profile(s) for many common exposure assessment situations. While not intended to address every possible scenario, the table provides guidance that should be applicable to the majority of commonly encountered job settings and employee tasks.

Analyte	Sampling Protocol (Section 6.1, 6.2)	Media	Flow Rate	Method	Notes
Diesel Exhaust					
Elemental Carbon	Diesel Particulates as Elemental Carbon	37 mm QFF	2 lpm	NIOSH 5040	Sample open face
Sulfur Dioxide	Sulfur Dioxide (AIM Commander)	AIM Commander	N/A	Electrochemical	Electrochemical sensors may give erroneous readings in presence of high levels of NO_2. In such situations, use method Sulfur Dioxide (SO_2), in Section 6.1
Anthracene Benzo(a)pyrene Chrysene Phenanthrene Pyrene Coal Tar Pitch Volatiles	PNA Scan (Polynuclear Aromatic Hydrocarbons) – TWA	37 mm GFF	2.0 lpm	OSHA 58	Store samples cold and protect from light.
THC as n-Hexane Benzene Naphthalene Toluene Ethylbenzene Xylene Kerosene Acetone MEK	Diesel Organic Scan	AT #541 Badge	N/A	NISH 1550, OSHA 7	N/A
Butadiene	Butadiene (Diesel Organic)	AT #541 Badge	N/A	OSHA 7	Collect on separate badge from other analytes
Acetaldehyde Crotonaldehyde Formaldehyde Glutaraldehyde	Aldehyde Scan (5)	AT #571	0.5 – 1.5 lpm	EPA TO-11	Store samples cold after collection

Analyte	Sampling Protocol (Section 6.1, 6.2)	Media	Flow Rate	Method	Notes
Propanaldehyde					
Acrolein	Acrolein	AT #592 Badge	8.56 cc/min	OSHA 52	N/A
Carbon Monoxide	Carbon Monoxide	AIM Commander	N/A	Electrochemical	N/A
Nitrogen Dioxide	Nitrogen Dioxide (NO2)	AIM Commander	N/A	Electrochemical	N/A
Ballast Dumping, General Track Maintenance					
Total Dust	Total Dust (with Silica)	5u PVC	2.0 lpm	NIOSH 0500, NIOSH 7500	N/A
Quartz					
Cristobalite					
Tridymite					
Respirable Dust	Respirable Dust (with Silica)	5 u PVC (with cyclone)	See cyclone documentation for required flow rate	NIOSH 0500, NIOSH 7500	Different cyclones use different flow rates; see documentation for the cyclone used for the appropriate flow rate
Quartz					
Cristobalite					
Tridymite					
Anthracene	PNA Scan (Polynuclear Aromatic Hydrocarbons) – TWA	37 mm GFF	2.0 lpm	OSHA 58	Store samples cold and protect from light.
Benzo(a)pyrene					
Chrysene					
Phenanthrene					
Pyrene					
Coal Tar Pitch Volatiles					
Sanding Operations, Other Dusty Conditions					
Total Dust	Total Dust (with Silica)	5u PVC	2.0 lpm	NIOSH 0500, NIOSH 7500	N/A
Quartz					
Cristobalite					
Tridymite					
Respirable Dust	Respirable Dust (with Silica)	5 u PVC (with cyclone)	See cyclone documentation for required flow rate	NIOSH 0500, NIOSH 7500	Different cyclones use different flow rates; see documentation for the cyclone used for the appropriate flow rate
Quartz					
Cristobalite					
Tridymite					
Welding, Grinding and Cutting Operations (Including Bridge Work)					
Antimony	Welding Fumes (13-metal scan) - TWA	37 mm 0.8u pre-weighed PVC	2.0 lpm	OSHA ID-125	Used pre-weighed filters; filters must come from same laboratory that will do analyses; PVC may be preferred to avoid filter weight gain due to humidity *Hexavalent Chromium requires separate analysis*
Beryllium					
Cadmium					
Chromium					
Cobalt					
Copper					
Iron					
Lead					
Manganese					
Molybdenum					
Vanadium					
Nickel					
Zinc					
Total Welding Fume					

Analyte	Sampling Protocol (Section 6.1, 6.2)	Media	Flow Rate	Method	Notes
Creosote Handling Operations					
Phenol (cresols)	XAD-7	ST 226-95	100 cc/min	NIOSH 2546	N/A
Benzene Toluene Ethyl benzene Xylene Styrene	BTEX	AT #541 Badge	N/A	OSHA-7	N/A
Anthracene Benzo(a)pyrene Chrysene Phenanthrene Pyrene Coal Tar Pitch Volatiles	PNA Scan (Polynuclear Aromatic Hydrocarbons) – TWA	37 mm GFF	2.0 lpm	OSHA 58	Store samples cold and protect from light.

6. Standard Sampling Methodologies

This section contains standard sampling methodologies applicable to the majority of sample work performed by the BNSF IH Group. While not intended to address every possible sampling scenario, these methodologies will help ensure consistency in sample collection protocols, procedures, media and analytical methods. These sections serve as valuable guides and references, useful for field preparation, as well.

6.1 Integrated Sampling Methodologies

This section describes protocols applicable to collection of integrated air samples, analyzed by an AIHA-accredited laboratory. Methods for using direct-reading instruments are found in section 6.2.

Acrolein	
Compound	**Standards**
Acrolein	OSHA PEL – 0.1 ppm ACGIH Ceiling –0.1 ppm
ppm -- Parts Per Million	

Method and Media

- Samples will be collected using an Assay Technology #592 badge.
- **Badge Flow Rate:** 8.56 cc/min
- **Recommended air volumes:** N/A
- **Sampling Media:** Assay Technology #592 badge
- **Limits of Detection:** 0.05 ppm
- **Analytical Method:** OSHA 52
- **Analytical Technique:** Gas Chromatography/Nitrogen Phosphorus Detector (GC/NPD)

Alcohol Scan	
Compound	**Standards**
n-Propyl alcohol	OSHA PEL-- 200 ppm ACGIH TLV-- 200 ppm ACGIH STEL-- 250 ppm
Ethyl alcohol	OSHA PEL-- 1000 ppm ACGIH TLV-- 1000 ppm
n-Butyl alcohol	OSHA PEL-- 100 ppm ACGIH TLV-- 20 ppm
s-butyl alcohol	OSHA PEL-- 150 ppm ACGIH TLV-- 100 ppm
t-butyl alcohol	OSHA PEL-- 100 ppm ACGIH TLV-- 100 ppm
Isopropyl Alcohol	OSHA PEL-- 400 ppm ACGIH TLV-- 200 ppm ACGIH STEL-- 400 ppm
ppm - Parts per Million	

Method and Media

- Samples will be collected using an Assay Technology #541 Badge.
- **Badge Flow Rate:** Varies with analyte
- **Recommended air volumes:** N/A
- **Sampling Media:** Assay Technology #541 Badge
- **Limits of Detection:** Varies with analyte
- **Analytical Method:** OSHA 7
- **Analytical Technique:** Gas chromatography/Flame Ionization Detector (GC/FID)

Aldehyde Scan (5)

Compound	Standards
Currently there is no OSHA standard that encompasses aldeyhydes as a whole or group.	
Acetaldehyde	OSHA PEL-- 200 ppm ACGIH Ceiling-- 25 ppm
Crotonaldehyde	OSHA PEL-- 2 ppm ACGIH Ceiling-- 0.3 ppm
Formaldehyde	OSHA PEL-- 0.75 ppm OSHA STEL-- 2 ppm ACGIH Ceiling-- 0.3 ppm
Glutaraldehyde	ACGIH Ceiling-- 0.05 ppm
Propanaldehyde	OSHA PEL-- N/A ACGIH TLV-- 20 ppm

ppm -- Parts Per Million
N/A -- Not Available

Method and Media

- Samples will be collected using an Assay Technologies #571 Badge
- **Pump flow settings:** N/A
- **Recommended air volumes:** N/A
- **Sampling Media:** AT #571 Badge
- **Limits of Detection:** Varies with analyte
- **Analytical Method:** EPA TO-11 (14)
- **Analytical Technique:** High Performance Liquid Chromatography (HPLC)
- **Additional Notes:** N/A

Asbestos in Air (TEM)

Compound	Standards
Asbestos	OSHA PEL-- 0.1 asbestos fibers (>5 µm long)/cc; 1 f/cc/30 min excursion ACGIH TLV-- 0.2 crocidolite; 0.5 amosite; 2 chrysotile and other asbestos, fibers/cc

Fibers/cc-- asbestos fibers per cubic centimeter of air

Method and Media

- Samples will be collected using an air sampling pump calibrated prior to and following the sampling excursion.
- **Pump flow settings:** 0.5 -16 liters per min.
- **Recommended air volumes:** 400 liters.
- **Sampling Media:** 0.45 µm cellulose ester membrane, 25-mm diameter
- **Limits of Detection:** 1 confirmed asbestos fiber above 95% of expected mean blank value
- **Analytical Method:** NIOSH 7402
- **Analytical Technique:** Transmission Electron Microscopy (TEM)
- **Additional Notes:** Sample with open faced filter; 2 to 10 field blanks per set. Check individual state regulations to determine license requirements prior to performing asbestos surveys, sampling and sampling submittal.

Asbestos in Air (PCM)

Compound	Standards
Asbestos	OSHA PEL-- 0.1 asbestos fibers (>5 µm long)/cc; 1 f/cc/30 min excursion ACGIH TLV-- 0.2 crocidolite; 0.5 amosite; 2 chrysotile and other asbestos, fibers/cc

Fibers/cc-- asbestos fibers per cubic centimeter of air

Method and Media

- Samples will be collected using an air sampling pump calibrated prior to and following the sampling excursion.
- **Pump flow settings:** 0.5 -16 liters per min.
- **Recommended air volumes:** 400 liters.
- **Sampling Media:** 0.8 µm cellulose ester membrane, 25-mm diameter
- **Limits of Detection:** 7 fiber/mm² of filter area
- **Analytical Method:** NIOSH 7400
- **Analytical Technique:** Phase Contrast Light Microscopy
- **Additional Notes:** Sample with open faced filter; 2 to 10 field blanks per set. Check individual state regulations to determine license requirements prior to performing asbestos surveys, sampling and sampling submittal.

Asbestos (bulk solids)

Compound	Standards
Asbestos- Standards for determining the presence of Asbestos Containing Material (ACM)	OSHA 29 CFR 1926.1101 & EPA 40 CFR 61 - Any material containing greater than one percent (1%) asbestos is considered asbestos containing material (ACM).

Method and Media

- Samples will be collected in accordance will all state and federal regulations in regards to sample methodology.
- **Analytical Method:** EPA 600/R-93/116
- **Analytical Technique:** Polarized Light Microscopy
- **Additional Notes:** Check individual state regulations to determine license requirements prior to performing asbestos surveys, sampling and sampling submittal.

Bisphenol - A	
Compound	**Standards**
Bisphenol - A	OSHA PEL-- 0.2 ppm ACGIH TLV-- 0.2 ppm
ppm -- Parts Per Million	

Method and Media

- Samples will be collected using an air sampling pump calibrated prior to and following the sampling excursion.
- **Pump flow settings:** 1.5 - 2.0 liters per min.
- **Recommended air volumes:** 288 liters.
- **Sampling Media:** Glass Fiber Filter (GFF)
- **Limits of Detection:** 0.4 micro-grams (*u*g)
- **Analytical Method:** NIOSH 333
- **Analytical Technique:** High Performance Liquid Chromatography (HPLC)

Butadiene (Diesel Organic)	
Compound	**Standards**
Butadiene	OSHA PEL-- 1 ppm OSHA STEL -- 5 ppm ACGIH TLV-- 2 ppm
ppm - Parts per Million	

Method and Media

- Samples will be collected using an Assay Technology #541 Badge.
- **Badge Flow Rate:** 6.42 cc/min
- **Recommended air volumes:** N/A
- **Sampling Media:** Assay Technology #541 badge
- **Limits of Detection:** 0.09 ppm
- **Analytical Method:** OSHA 7 or equivalent NIOSH method
- **Analytical Technique:** Gas chromatography/Flame Ionization Detector (GC/FID)

BTEX	
Compound	**Standards**
Benzene	OSHA PEL --1 ppm OSHA Ceiling-- 5 ppm ACGIH TLV -- 0.5 ppm ACGIH STEL -- 2.5 ppm
Toluene	OSHA PEL-- 200 ppm OSHA Ceiling -- 300 ppm ACGIH TLV-- 50 ppm
Ethyl-Benzene	OSHA PEL-- 100 ppm ACGIH TLV-- 100 ppm ACGIH STEL --125 pm
Xylene (o-xylene, m-xylene, & p-xylene isomers)	OSHA PEL-- 100 ppm ACGIH TLV-- 100 ppm ACGIH STEL-- 150 ppm
mg/M^3- Milligrams per Cubic Meter of Air N/A- Not Available	

Method and Media

- Samples will be collected using an Assay Technology #541 Badge
- **Pump flow settings:** Varies with analyte
- **Recommended air volumes:** N/A
- **Sampling Media:** Assay Technology #541 Badge
- **Limits of Detection:** Varies with analyte
- **Analytical Method:** OSHA 7
- **Analytical Technique:** Gas chromatography/Flame Ionization Detector (GC/FID)

Chlorinated Solvents Scan

Compound	Standards
Chlorobenzene	OSHA PEL -- 75 ppm ACGIH TLV-- 10 ppm
Chloroform	OSHA PEL-- 50 ppm ACGIH TLV-- 10 ppm
1,1- Dichloroethane	OSHA PEL-- 100 ppm ACGIH TLV-- 100 ppm
1,2- Dichloroethylene	OSHA PEL-- 200 ppm ACGIH TLV-- 200 ppm
Hexachloroethane	OSHA PEL-- 1 ppm ACGIH TLV-- 1 ppm
Tetrachloroethylene	OSHA PEL-- 100 ppm OSHA Ceiling-- 200 ppm ACGIH TLV-- 25 ppm ACGIH STEL -- 100 ppm
Trichoroethane	OSHA PEL-- 350 ppm ACGIH TLV-- 350 ppm ACGIH STEL -- 450 ppm
1,1,1- Trichloroethane	OSHA PEL-- 350 ppm ACGIH TLV-- 350 ppm ACGIH STEL -- 450 ppm
1,1,2- Trichloroethane	OSHA PEL-- 350 ppm ACGIH TLV-- 350 ppm ACGIH STEL -- 450 ppm

ppm -- Parts Per Million

Method and Media

- Samples will be collected using an Assay Technology #546 Badge
- **Badge Flow Rate:** Varies with analyte
- **Recommended air volumes:** N/A
- **Sampling Media:** Assay Technology #546 Badge
- **Limits of Detection:** Varies with analyte
- **Analytical Method:** OSHA 7
- **Analytical Technique:** High Performance Liquid Chromatography (HPLC)

Chromium, Hexavalent (Cr^6)	
Compound	**Standards**
Chromium, hexavalent	OSHA PEL-- 0.5 mg/M³ • Proposed change to 0.001 mg/m3 • Proposed action level of 0.005 mg/m3 ACGIH TLV-- 0.5 mg/M³
mg/M³ = milligrams per cubic meter	

Method and Media

- Samples will be collected using an air sampling pump calibrated prior to and following the sampling excursion.
- **Pump flow settings:** 2.0 liters per min.
- **Recommended air volumes:** 960 liters.
- **Sampling Media:** 37 mm 5 micron PVC filter
- **Limits of Detection:** 0.01 micrograms
- **Analytical Method:** OSHA ID-215
- **Analytical Technique:** Ion chromatography (IC); prefer closed-face collection.

Coal, Tar, Pitch Volatiles (as Benzene)

Compound	Standards
Coal, Tar, Pitch Volatiles	OSHA PEL-- 0.2 mg/M³ ACGIH TLV-- 0.2 mg/M³

mg/M³- Milligrams per Cubic Meter of Air

Method and Media

- Samples will be collected using an air sampling pump calibrated prior to and following the sampling excursion.
- **Pump flow settings:** 2.0 liters per min.
- **Recommended air volumes:** 200 - 1,000 liters.
- **Sampling Media:** Glass Fiber Filter (GFF).
- **Limits of Detection:** Information not Available
- **Analytical Method:** OSHA 58
- **Analytical Technique:** Wet Chemistry, Includes colorimetric, titrimetric, and visible spectrometry analyses
- **Additional Notes:** Store samples in cold and protect from light.

Diesel Particulates as Elemental Carbon

Compound	Standards
Elemental Carbon	OSHA PEL-- N/A ACGIH TLV-- N/A

N/A -- Not Available

Method and Media

- Samples will be collected using an air sampling pump calibrated prior to and following the sampling excursion.
- **Pump flow settings:** 1.0 - 4.0 liters per min.
- **Recommended air volumes:** 106 - 4300 liters.
- **Sampling Media:** Quartz-baked (37 mm) Filter
- **Limits of Detection:** 4 micro-grams (*u*g)
- **Analytical Method:** NIOSH 5040
- **Analytical Technique:** Thermal-optical detector
- **Additional Notes:** See method for various sampling scenarios; at least one field blank is required. LOD for elemental carbon is 2 µg. Sample with open-face filter.

Diesel Organic Scan

Compound	Standards
Total Hydorcarbons as n-Hexane (THC)	OSHA Ceiling-- N/A ACGIH TLV-- N/A
Benzene	OSHA PEL --1 ppm OSHA Ceiling-- 5 ppm ACGIH TLV -- 0.5 ppm ACGIH STEL -- 2.5 ppm
Toluene	OSHA PEL-- 200 ppm OSHA Ceiling -- 300 ppm ACGIH TLV-- 50 ppm
Ethyl-Benzene	OSHA PEL-- 100 ppm ACGIH TLV-- 100 ppm ACGIH STEL --125 pm
Xylene (o-xylene, m-xylene, & p-xylene isomers)	OSHA PEL-- 100 ppm ACGIH TLV-- 100 ppm ACGIH STEL-- 150 ppm
Kerosene	OSHA Ceiling-- N/A ACGIH TLV-- 200 mg/M³
Acetone	OSHA PEL --1000 ppm ACGIH TLV -- 500 ppm ACGIH STEL -- 750 ppm
Methyl Ethyl Ketone (MEK)	OSHA PEL --200 ppm ACGIH TLV -- 200 ppm ACGIH STEL -- 300 ppm
Naphthalene	OSHA PEL – 10 ppm ACGIH TLV – 10 ppm

ppm -- Parts Per Million
mg/M³- Milligrams per Cubic Meter of Air
N/A- Not Available

Method and Media

- Samples will be collected using an Assay Technology #541 Badge
- **Badge Flow Rate:** Varies with analyte
- **Recommended air volumes:** N/A
- **Sampling Media:** Assay Technology #541 badge
- **Limits of Detection:** Varies with analyte
- **Analytical Method:** (THC) & Kerosene - NIOSH 1550; Benzene, other organics – OSHA 7
- **Analytical Technique:** Gas chromatography/Flame Ionization Detector (GC/FID)

Epichlorohydrin	
Compound	**Standards**
Epichlorohydrin	OSHA PEL-- 5 ppm ACGIH TLV-- 0.5 ppm
ppm -- Parts Per Million	

Method and Media

- Samples will be collected using an Assay Technology #541 Badge.
- **Badge Flow Rate:** 5.57 cc/min
- **Recommended air volumes:** N/A
- **Sampling Media:** Assay Technology #541 Badge
- **Limits of Detection:** 0.1 ppm
- **Analytical Method:** OSHA 7 or equivalent NIOSH method
- **Analytical Technique:** Gas chromatography/Flame Ionization Detector (GC/FID)

Lead (bulk solids)	
Compound	**Standards**
Lead (paint Chips)	EPA standard-- 1mg/cm² or 5% by weight (5000 mg/Kg)
mg/cm² - micrograms per square centimeter of surface area. Mg/Kg - Milligram per Killogram	

Method and Media

- If results in weight percent are needed, collect approximately 1 gram. If results in mg/cm2 are needed, scrape off 1cm2 of paint, using a template to score the area to be sampled.
- **Limits of Detection:** 2 micro-grams (*u*g)
- **Analytical Method:** EPA SW 6010
- **Analytical Technique:** Inductively Coupled Argon Plasma Spectroscopy (ICP)
- **Additional Notes:** confirm with individual state regulations to determine license requirements prior to performing lead surveys or sampling.

Lead (Wipe Samples)

Compound	Standards
Lead	HUD Standard – 40 ug/ft²

ug/ft² - micrograms per square foot

Method and Media

- Using a template or adhesive tape, without disturbing the sampling surface. Wipe in an "S" motion, fold the contaminated side inward, and "S" wipe again, perpendicular to the first motion. Fold wipe with contaminated side inward and place in vial.
- **Media:** ASTM approved wipe kits
- **Limits of Detection:** 2 micro-grams (*u*g)
- **Analytical Method:** OSHA ID-125G
- **Analytical Technique:** Inductively Coupled Argon Plasma Spectroscopy (ICP)
- **Additional Notes:** confirm with individual state regulations to determine license requirements prior to performing lead surveys or sampling.

Isocyanate Scan

Compound	Standards
Hexamethylene Diisocyanate (HDI)	OSHA PEL --0.005 ppm ACGIH TLV -- 0.5 ppm
Methylene Bisphenyl Isocynate (MDI)	OSHA PEL-- 0.02 ppm, ACGIH TLV-- 0.005 ppm
2,4 Toluene Diisocynate (2,4-TDI)	OSHA PEL-- 0.02 ppm, ACGIH TLV-- 0.005 ppm
2,6- Toluene Diisocynate (2,6-TDI)	OSHA PEL-- 0.02 ppm, ACGIH TLV-- 0.005 ppm

ppm -- Parts Per Million

Method and Media

- Samples will be collected using an air sampling pump calibrated prior to and following the sampling excursion.
- **Pump flow settings:** 1.0 liters per min.
- **Recommended air volumes:** 15 - 240 liters.
- **Sampling Media:** Treated Glass Fiber Filter (GFF)
- **Limits of Detection:** 0.2 micro-grams (*u*g)
- **Analytical Method:** OSHA 42/47
- **Analytical Technique:** High Performance Liquid Chromatography (HPLC)
- **Additional Notes:** Sample open-faced. Store samples cold and protect from light.

Methyl Alcohol

Compound	Standards
Methyl Alcohol	OSHA PEL-- 200 ppm ACGIH TLV-- 200 ppm ACGIH STEL-- 250 ppm

ppm - Parts per Million

Method and Media

- Samples will be collected using an air sampling pump calibrated prior to and following the sampling excursion.
- **Pump flow settings:** 0.02 -0.2 liters per min.
- **Recommended air volumes:** 1 - 5 liters.
- **Sampling Media:** Silica gel tube (SG) (225-mg) (SKC 226-10)
- **Limits of Detection:** 4 micro-grams (ug)
- **Analytical Method:** NIOSH 2000
- **Analytical Technique:** Gas chromatography/Flame Ionization Detector (GC/FID)
- **Additional Notes:** Store samples in cold.

Methylene Chloride

Compound	Standards
Methylene Chloride	OSHA PEL-- 25 ppm OSHA STEL-- 125ppm ACGIH TLV-- 50 ppm

ppm -- Parts Per Million

Method and Media

- Samples will be collected using an Assay Technology #541 Badge
- **Badge Flow Rate:** 6.43 cc/min
- **Recommended air volumes:** 3 liters.
- **Sampling Media:** Assay Technology #541 Badge
- **Limits of Detection:** 0.3 ppm
- **Analytical Method:** OSHA 80
- **Analytical Technique:** Gas chromatography/Flame Ionization Detector (GC/FID)

Methyl Ethyl Ketone (MEK)

Compound	Standards
Methyl Ethyl Ketone (MEK) 2-Butanone	OSHA PEL-- 200 ppm ACGIH TLV-- 200 ppm ACGIH STEL-- 300ppm

ppm -- Parts Per Million

Method and Media

- Samples will be collected using an Assay Technology #546 Badge
- **Badge Flow Rate:** 1.15 cc/min
- **Recommended air volumes:** N/A
- **Sampling Media:** Assay Technology #546 badge
- **Limits of Detection:** 0.5 ppm
- **Analytical Method:** OSHA 7 or equivalent NIOSH method
- **Analytical Technique:** Gas chromatography/Flame Ionization Detector (GC/FID)

Oxides of Nitrogen (NOx)

Compound	Standards
Nitric Oxide	OSHA PEL-- 25 ppm ACGIH TLV-- 25 ppm
Nitrogen Dioxide	OSHA Ceiling-- 1 ppm ACGIH TLV-- 3 ppm ACGIH STEL -- 5 ppm

ppm -- Parts Per Million

Method and Media

- Samples will be collected using an air sampling pump calibrated prior to and following the sampling excursion.
- **Pump flow settings:** 0.025 liters per min.
- **Recommended air volumes:** 1.5 - 6.0 liters.
- **Sampling Media:** Molecular sieve set (SKC 226-40). Set of 3 tubes
- **Limits of Detection:** NO - 3 micro-grams (*u*g), NO_2 - 2 micro-grams (*u*g)
- **Analytical Method:** NIOSH 6014
- **Analytical Technique:** Wet Chemistry, Includes colorimetric, titrimetric, and visible spectrometry analyses
- **Additional Notes:** Sampling Train: Tube A: 400 mg TEA-coated molecular sieve (type 13x, 0-40 mesh) Tube B: 800 mg oxidizer (chromate) to convert NO to NO 2. Tube C: Same as Tube A. Store Cold.

Nitrogen Dioxide (NO_2)

Compound	Standards
Nitrogen Dioxide	OSHA Ceiling-- 5 ppm ACGIH TLV-- 3 ppm ACGIH STEL -- 5 ppm

ppm -- Parts Per Million

Method and Media

- Samples will be collected using an air sampling pump calibrated prior to and following the sampling excursion.
- **Pump flow settings:** 0.2 liters per min.
- **Recommended air volumes:** 3.0 liters.
- **Sampling Media:** Molecular sieve (Triethanoiamine) (SKC 226-40-02)
- **Limits of Detection:** 2 micro-grams (*u*g)
- **Analytical Method:** OSHA ID-182
- **Analytical Technique:** Ion Chromatography (IC)
- **Additional Notes:** Store Cold.

Sulfur Dioxide (SO_2)

Compound	Standards
Sulfur Dioxide (SO_2)	OSHA PEL-- 5 ppm ACGIH TLV-- 2 ppm

ppm -- Parts Per Million
N/A -- Not Available

Method and Media

- Samples will be collected using an air sampling pump calibrated prior to and following the sampling excursion.
- **Pump flow settings:** 0.5 - 1.5 liters per min.
- **Recommended air volumes:** 4 - 200 liters.
- **Sampling Media:** Mixed Cellulose Ester Filter (MCE) with treated Whatman (for SO2)
- **Limits of Detection:** 10 micro-grams (*u*g)
- **Analytical Method:** NIOSH 6004
- **Analytical Technique:** Ion Chromatography (IC)
- **Additional Notes:** Do not exceed 2 mg of particulate loading on filter.

PAH Scan (Polynuclear Aromatic Hydrocarbons) -- TWA

Compound	Standards
Coal, Tar, Pitch Volatiles	**OSHA PEL for: 0.2 mg/M³**
Anthracene	OSHA PEL-- 0.2 mg/M³ ACGIH TLV-- N/A
Benzo(a)pyrene	OSHA PEL-- 0.2 mg/M³ ACGIH TLV-- N/A
Chrysene	OSHA PEL-- 0.2 mg/M³ ACGIH TLV-- N/A
Phenanthrene	OSHA PEL-- 0.2 mg/M³ ACGIH TLV-- N/A
Pyrene	OSHA PEL-- 0.2 mg/M³ ACGIH TLV-- N/A

mg/M³- Milligrams per Cubic Meter of Air
N/A- Not Available

Method and Media

- Samples will be collected using an air sampling pump calibrated prior to and following the sampling excursion.
- **Pump flow settings:** 2.0 liters per min.
- **Recommended air volumes:** 200 - 1,000 liters.
- **Sampling Media:** Glass Fiber Filter (GFF).
- **Limits of Detection:** Information not Available
- **Analytical Method:** OSHA 58
- **Analytical Technique:** High Performance Liquid Chromatography (HPLC)
- **Additional Notes:** Store samples in cold and protect from light.

Polychlorobiphenyls (PCBs)

Compound	Standards
Polychlorobiphenyls (PCBs)	OSHA PEL-- 0.2 ppm ACGIH TLV-- 0.2 ppm

ppm -- Parts Per Million

Method and Media

- Samples will be collected using an air sampling pump calibrated prior to and following the sampling excursion.
- **Pump flow settings:** 0.05 - 0.2 liters per min.
- **Recommended air volumes:** 1 - 50 liters.
- **Sampling Media:** Glass Fiber Filter - 13mm(GFF-13mm)/ Florisil (SKC 226-39)
- **Limits of Detection:** 0.1 micro-grams (*u*g)
- **Analytical Method:** NIOSH 5303
- **Analytical Technique:** Gas chromatography/Electron Capture Detector (GC/ECD)
- **Additional Notes:** Protect from light; transfer filter to glass vial w/ teflon-lined cap.

Respirable Dust (with Silica)

Compound	Standards
Quartz	ACGIH TLV-- 0.05 mg/M³
Cristobalite	ACGIH TLV-- 0.05 mg/M³
Tridymite	ACGIH TLV-- 0.05 mg/M³
Respirable Dust	See OSHA PEL for Respirable Dust containing crystalline silica

mg/M³- Milligrams per Cubic Meter of Air
N/A - Not Available

Method and Media

- Samples will be collected using an air sampling pump calibrated prior to and following the sampling excursion.
- **Pump flow settings:** 1.5 - 2.0 Liters per minute or see cyclone instructions for recommended flow rate.
- **Recommended air volumes:** 400 - 1,000 liters.
- **Sampling Media:** Pre-weighted Polyvinyl Chloride (PVC) 5 µm used with a cyclone, which determines 2- or 3-pc. cassette
- **Limits of Detection:** 20 micro-grams (*u*g)
- **Analytical Method:** NIOSH 7500
- **Analytical Technique:** X-Ray Diffraction (XRD)
- **Additional Notes:** To determine quartz, cristobalite and tridymite concentrations instruct laboratory to report the percent crystalline silica

Respirable Dust (without Silica)

Compound	Standards
Respirable Dust	OSHA PEL-- 5 mg/M³ ACGIH TLV-- N/A

mg/M³- Milligrams per Cubic Meter of Air
N/A - Not Available

Method and Media

- Samples will be collected using an air sampling pump calibrated prior to and following the sampling excursion.
- **Pump flow settings:** Refer to Cyclone instructions to determine Flow rates.
- **Recommended air volumes:** 75 - 1,000 liters.
- **Sampling Media:** Pre-weighted Polyvinyl Chloride PVC 5 *u*m cassette to be used with a cyclone attachment.
- **Limits of Detection:** 50 micro-grams (*u*g)
- **Analytical Method:** NIOSH 0600
- **Analytical Technique:** Gravimetric
- **Additional Notes:** Requires use of a cyclone; follow cyclone manufacturer's instructions for flow rate.

Total Dust (without Silica)

Compound	Standards
Total Dust	OSHA PEL-- 15 mg/M³ ACGIH TLV-- N/A

mg/M³- Milligrams per Cubic Meter of Air
N/A - Not Available

Method and Media

- Samples will be collected using an air sampling pump calibrated prior to and following the sampling excursion.
- **Pump flow settings:** 1.5 - 2.0 Liters per minute
- **Recommended air volumes:** 25 - 1,000 liters.
- **Sampling Media:** Pre-weighted Polyvinyl Chloride (PVC) 5 *u*m (2 piece)
- **Limits of Detection:** 50 micro-grams (*u*g)
- **Analytical Method:** NIOSH 0500
- **Analytical Technique:** Gravimetric
- **Additional Notes:** Closed face sampling preferred. When sampling is done in conjunction with a Welding Fume Scan a 0.8 um Pre-weighted Polyvinyl Chloride (PVC) filter should be used.

Total Dust (with Silica)	
Compound	**Standards**
Quartz	None
Cristobalite	None
Tridymite	None
Total Dust	See OSHA PEL for total dust containing crystalline silica

mg/M³- Milligrams per Cubic Meter of Air
N/A - Not Available

Method and Media

- Samples will be collected using an air sampling pump calibrated prior to and following the sampling excursion.
- **Pump flow settings:** 1.5 - 2.0 Liters per minute or see cyclone instructions for recommended flow rate.
- **Recommended air volumes:** 400 - 1,000 liters.
- **Sampling Media:** Pre-weighted Polyvinyl Chloride (PVC) 5 µm (For respirable, use a cyclone, which determines 2- or 3-pc. cassette)
- **Limits of Detection:** 20 micro-grams (*u*g)
- **Analytical Method:** NIOSH 7500
- **Analytical Technique:** X-Ray Diffraction (XRD)
- **Additional Notes:** Requires use of a cyclone for respirable dust collection. To determine quartz, cristobalite and tridymite concentrations instruct laboratory to report the percent crystalline silica

Welding Fumes (13 metal scan)-- TWA

Compound	Standards
Welding fumes	**OSHA PEL for: 5 mg/M³**
Antimony	OSHA PEL-- 0.5 mg/M³ ACGIH TLV-- 0.5 mg/M³
Beryllium	OSHA PEL-- 2 *u*g/M³ OSHA Ceiling-- 5 *u*g/M³ ¹ACGIH TLV-- 0.002 mg/M³
Cadmium	Cd fumes OSHA PEL-- 1 mg/M³ Cd fumes OSHA Ceiling-- 3 mg/M³ ACGIH TLV-- 0.01 mg/M³
Chromium	OSHA PEL-- 0.5 mg/M³ ACGIH TLV-- 0.5 mg/M³
Cobalt	OSHA PEL-- 0.1 mg/M³ ACGIH TLV-- 0.02 mg/M³
Copper	Cu fumes OSHA PEL-- 0.1 mg/M³ Cu fumes ACGIH TLV-- 0.2 mg/M³
Iron (as Iron Oxide)	OSHA PEL-- 10 mg/M³ ACGIH TLV-- 5 mg/M³
Lead	OSHA PEL-- 50 *u*g/M³ ACGIH TLV-- 0.05 mg/M³
Manganese	OSHA PEL-- 5 mg/M³ ²ACGIH TLV-- 0.2 mg/M³
Molybdenum	Soluble compounds OSHA PEL-- 5 mg/M³ Insoluble compounds OSHA PEL-- 15 mg/M³ Soluble compounds ACGIH TLV--0.5 mg/M³ Insoluble compounds ACGIH TLV--3 mg/M³
Nickel	OSHA PEL-- 1 mg/M³ ACGIH TLV-- 0.1 mg/M³
Vanadium (as Vanadium Pentoxide)	OSHA PEL as fumes-- 0.1 mg/M³ OSHA PEL as dust-- 0.5 mg/M³ ACGIH TLV-- 0.5 mg/M³
Zinc (as Zinc Oxide)	Total Dust OSHA PEL--15 mg/M³ Zinc Fumes OSHA PEL-- 5 mg/M³ ACGIH TLV-- 2 mg/M³ ACGIH STEL-- 10 mg/M³
Total Welding Fume	OSHA PEL – 15 mg/M³

¹ ACGIH TLV- notice of intended change from 0.002 mg/M³ to 0.0002 mg/M³
² ACGIH TLV- notice of intended change from 0.2 mg/M³ to 0.03 mg/M³
mg/M³- Milligrams per Cubic Meter of Air
*u*g/M³- Micrograms per Cubic Meter of Air

Method and Media

- Samples will be collected using an air sampling pump calibrated prior to and following the sampling excursion.
- **Pump flow settings:** 1.0 - 3.0 liters per min.
- **Recommended air volumes:** 250 - 1,000 liters.
- **Sampling Media:** Pre-weighed 37 mm 0.8 micron PVC filter
- **Limits of Detection:** Variable due to the number of analytes being sampled for.
- **Analytical Method:** OSHA ID-125
- **Analytical Technique:** Inductively Coupled Argon Plasma Spectroscopy (ICAP); prefer closed-face collection.

6.2 Direct-Reading Instrument Protocols

This section describes protocols applicable to collection of air samples using direct-reading instrumentation. Methods for using integrated air sampling protocols are found in section 6.1.

Ammonia	
Compound	Standards
Ammonia (NH_3)	OSHA PEL-- 50 ppm ACGIH TLV--25 ppm ACGIH STEL-- 35ppm
ppm - Parts per Million	
Direct Reading Instrument	
Sensidyne Tubes	**Tube #:** 1058 A **Measuring Range:** 0.1 - 5.0 %vol **Number of Strokes:** 1 **Tube #:** 1058 B **Measuring Range:** 50 - 900 ppm **Number of Strokes:** 1 **Tube #:** 1058 C **Measuring Range:** 5 - 260 ppm **Number of Strokes:** 1-2 **Tube #:** 1058 D **Measuring Range:** 0.2 - 20 ppm **Number of Strokes:** 1-5 **Tube #:** 1058 M **Measuring Range:** 0.1 - 1.0 %vol **Number of Strokes:** 1
Air Commander	**Sensor Type:** Electrochemical **Factory Set Alarm Point:** 25 ppm **Measuring Range:** 0-100 ppm **Resolution:** 1 ppm **STEL Factory Set Alarm Point:** 35 ppm **TWA FActory Set Alarm Point:** 25 ppm
Drager CMS	**SKC Chip #:** 802-06550 **Measuring Range:**0.2 - 5.0 ppm **SKC Chip #:** 802-06130 **Measuring Range:** 2 - 50 ppm **SKC Chip #:** 802-06020 **Measuring Range:** 10 - 150 ppm **SKC Chip #:** 802-06570 **Measuring Range:** 100 - 2000 ppm

Carbon Monoxide	
Compound	Standards
Carbon Monoxide	OSHA PEL-- 50 ppm ACGIH TLV--25 ppm
ppm - Parts per Million	
Direct Reading Instrument	
Sensidyne Tubes	**Tube #:** 1068 **Measuring Range:** 10 - 250 ppm **Number of Strokes:** 3 **Tube #:** 1068 A **Measuring Range:** 5 - 1000 ppm **Number of Strokes:** 1-4 **Tube #:** 1068 C **Measuring Range:** 5 - 50 ppm **Number of Strokes:** 1 **Tube #:** 1058 H **Measuring Range:** 0.1 - 2 %vol **Number of Strokes:** 1
Aim Commander	**Sensor Type:** Electrochemical **Factory Set Alarm Point:** 35 ppm **Measuring Range:** 0-500 ppm **Resolution:** 1 ppm **STEL Factory Set Alarm Point:** 200 ppm **TWA FActory Set Alarm Point:** 35 ppm
Drager CMS	**SKC Chip #:** 802-06080 **Measuring Range:** 5 - 150 ppm

Chlorine	
Compound	Standards
Chlorine (Gas)	OSHA PEL-- 1 ppm OSHA Ceiling -- 1 ppm ACGIH TLV--0.5 ppm ACGIH STEL-- 1 ppm
ppm - Parts per Million	
Direct Reading Instrument	
Sensidyne Tubes	**Tube #:** 1098 A **Measuring Range:** 1 - 40 ppm **Number of Strokes:** 3 **Tube #:** 1098 B **Measuring Range:** 0.1 - 10 ppm **Number of Strokes:** 1-5 **Tube #:** 109 U **Measuring Range:** 0.05 - 2.0 ppm **Number of Strokes:** 1-2
Aim Commander	**Sensor Type:** Electrochemical **Factory Set Alarm Point:** 0.5 ppm **Measuring Range:** 0-5 ppm **Resolution:** 0.1 ppm **STEL Factory Set Alarm Point:** 1 ppm **TWA FActory Set Alarm Point:** 0.5 ppm
Drager CMS	**SKC Chip #:** 802-06010 **Measuring Range:** 0.2 - 10 ppm

Hydrogen Sulfide (H2S)	
Compound	Standards
Hydrogen Sulfide (H2S)	OSHA Ceiling -- 20 ppm OSHA Peak -- 50 ppm ACGIH TLV-- 10 ppm ACGIH STEL-- 15 ppm
ppm - Parts per Million	
Direct Reading Instrument	
Sensidyne Tubes	**Tube #:** 1208 B **Measuring Range:** 0.75 - 300 ppm **Number of Strokes:** ½ -4 **Tube #:** 1208 C **Measuring Range:** 0.005 -0.16 %vol **Number of Strokes:** 1 **Tube #:** 1208 D **Measuring Range:** 1 -60 ppm **Number of Strokes:** ½ -1 **Tube #:** 1208 E **Measuring Range:** 0.5 - 40 ppm **Number of Strokes:** ½ -2 **Tube #:** 1208 F **Measuring Range:** 25 - 2000 ppm **Number of Strokes:** ½ -2 **Tube #:** 1208 M **Measuring Range:** 0.005 -1.2 %vol **Number of Strokes:** ½ -1
Aim Commander	**Sensor Type:** Electrochemical **Factory Set Alarm Point:** 10 ppm **Measuring Range:** 0-100 ppm **Resolution:** 1 ppm **STEL Factory Set Alarm Point:** 15 ppm **TWA FActory Set Alarm Point:** 10 ppm
Drager CMS	**SKC Chip #:** 802-06520 **Measuring Range:**0.2 - 5.0 ppm **SKC Chip #:** 802-06050 **Measuring Range:** 2 - 50 ppm **SKC Chip #:** 802-06150 **Measuring Range:** 20 - 500 ppm **SKC Chip #:** 802-06220 **Measuring Range:** 100 - 2,500 ppm

Nitrogen Dioxide (NO2)	
Compound	Standards
Nitrogen Dioxide	OSHA PEL -- 5 ppm OSHA Ceiling -- 5 ppm ACGIH TLV-- 3 ppm ACGIH STEL-- 5 ppm
ppm - Parts per Million	
Direct Reading Instrument	
Sensidyne Tubes	**Tube #:** 1178 A **Measuring Range:** 20 - 1000 ppm **Number of Strokes: 1** **Tube #:** 1178 B **Measuring Range:** 0.5 - 30 ppm **Number of Strokes:** 2 **Tube #:** 1178 C **Measuring Range:** 0.1 - 1.0 ppm **Number of Strokes:** 3
Aim Commander	**Sensor Type:** Electrochemical **Factory Set Alarm Point:** 1 ppm **Measuring Range:** 0-20 ppm **Resolution:** 0.1 ppm **STEL Factory Set Alarm Point:** 5 ppm **TWA Factory Set Alarm Point:** 3 ppm
Drager CMS	**SKC Chip #:** 802-06120 **Measuring Range:** 0.5 - 25 ppm **SKC Chip #:** 802-06060 » Detects both Nitric Oxide (NO) and Nitrogen Dioxide (NO_2) **Measuring Range:** 0.5 - 25 ppm **SKC Chip #:** 802-06240 » Detects both Nitric Oxide (NO) and Nitrogen Dioxide (NO_2) **Measuring Range:** 0.5 - 25 ppm

Sulfur Dioxide (SO2)	
Compound	Standards
Sulfur Dioxide	OSHA PEL -- 5 ppm ACGIH TLV-- 2 ppm ACGIH STEL-- 5 ppm
ppm - Parts per Million	
Direct Reading Instrument	
Sensidyne Tubes	**Tube #:** 1038 A **Measuring Range:** 0.1 - 3.0 %vol **Number of Strokes:** 1 **Tube #:** 1038 B **Measuring Range:** 0.02 - 0.3 %vol **Number of Strokes:** 1 **Tube #:** 1038 C **Measuring Range:** 20 - 300 ppm **Number of Strokes:** 1-2 **Tube #:** 1038 D **Measuring Range:** 1 - 60 ppm **Number of Strokes:** 1-5 **Tube #:** 1038 E **Measuring Range:** 0.25 - 10 ppm **Number of Strokes:** 1
Aim Commander	**Sensor Type:** Electrochemical **Factory Set Alarm Point:** 2 ppm **Measuring Range:** 0-20 ppm **Resolution:** 0.1 ppm **STEL Factory Set Alarm Point:** 5 ppm **TWA FActory Set Alarm Point:** 2 ppm **Note:** Electrochemical sensors may give erroneous readings in the presence of high levels of NO_2.
Drager CMS	**SKC Chip #:** 802-06110 **Measuring Range:** 0.4 - 10 ppm **SKC Chip #:** 802-06180 **Measuring Range:** 5 - 150 ppm

Appendix A. Standard Forms

Burlington Northern Santa Fe Railroad

Industrial Hygiene Project File

Project Name:	
Start Date:	
End Date:	
Project Class:	
Job Setting:	
Facilities Studied:	
Project Owner:	
Project ID:	

File Contents

Field Data Collection Records			
Sample Date	**Number of Sample Records**	**Number of Dosimetry Records**	**Calibration Logs Included**
			□ Yes □ No
			□ Yes □ No
			□ Yes □ No
			□ Yes □ No
			□ Yes □ No
			□ Yes □ No

Additional Documentation		
Item	**Included?**	**No. of Documents**
Laboratory Chain of Custody Records	□ Yes □ No	
Laboratory Analysis Reports	□ Yes □ No	
Correspondence (Letters, emails, etc.)	□ Yes □ No	
Reference Materials (Schedules, MSDS, articles, etc.)	□ Yes □ No	
Employee Notification Letters	□ Yes □ No	
Weather Reports	□ Yes □ No	
Consultant or Other Third Party Reports	□ Yes □ No	
Invoices or Financial Records	□ Yes □ No	
Photographs / Videos	□ Yes □ No	
Printouts from Dosimeters/DRI	□ Yes □ No	

File Tracking

Item	Project Created	Lab Report Received	File Packet Assembled	Data Entry Request	Data Entry Reviewed	Submitted to File	Filing Completed
Date							
Initials							

Form 1. Project Profile and Notes

Information Applicable to All Samples in this Set					
Project ID:		**Collection Date:**		**Collected By:**	
Facility:		**Business Unit:**			
Job Setting:		**Environment:**			
Building:		**Analytical Profile:**			

Tools and Equipment Applicable to All Samples:

Name of Equipment Item	Model Number, other desc

Task Information Applicable to All Samples:

Task Name	Duration Interval

Exposure Modifiers Applicable to All Samples:

Name of Exposure Modifier	Potential Impact	Comments

Personal Protective Equipment Used by Employees:

- □ Safety boots, leather
- □ Hardhats, plastic
- □ Safety glasses
- □ Gloves, leather
- □ Ear plugs

List additional PPE items used by ALL employees sampled here:

Field Notes and Observations:

Field Notes and Observations:

Field Notes and Observations:

Field Notes and Observations:

Field Notes and Observations:

Field Notes and Observations:

Form 2: Field Sample Index	Facility:	Collected by:
	Project Name/Number:	

Date	Sample ID Pump Number	Employee Employee ID	Location / Description	Pre Sample Value	Start	Stop	Post Sample Value	Runtime (min)	Volume (L) (Air Samples Only)
	☐ Personal ☐ Area ☐ Grab ☐ Bulk ☐ Blank	☐ TWA ☐ STEL ☐ Ceiling ☐ Environmental Standard	Reported Job Title	☐ Sample Period TWA ☐ 8-Hour TWA ☐ Extended Shift TWA			Shift Duration:	Job Code	
	☐ Personal ☐ Area ☐ Grab ☐ Bulk ☐ Blank	☐ TWA ☐ STEL ☐ Ceiling ☐ Environmental Standard	Reported Job Title	☐ Sample Period TWA ☐ 8-Hour TWA ☐ Extended Shift TWA			Shift Duration:	Job Code	
	☐ Personal ☐ Area ☐ Grab ☐ Bulk ☐ Blank	☐ TWA ☐ STEL ☐ Ceiling ☐ Environmental Standard	Reported Job Title	☐ Sample Period TWA ☐ 8-Hour TWA ☐ Extended Shift TWA			Shift Duration:	Job Code	
	☐ Personal ☐ Area ☐ Grab ☐ Bulk ☐ Blank	☐ TWA ☐ STEL ☐ Ceiling ☐ Environmental Standard	Reported Job Title	☐ Sample Period TWA ☐ 8-Hour TWA ☐ Extended Shift TWA			Shift Duration:	Job Code	
	☐ Personal ☐ Area ☐ Grab ☐ Bulk ☐ Blank	☐ TWA ☐ STEL ☐ Ceiling ☐ Environmental Standard	Reported Job Title	☐ Sample Period TWA ☐ 8-Hour TWA ☐ Extended Shift TWA			Shift Duration:	Job Code	
	☐ Personal ☐ Area ☐ Grab ☐ Bulk ☐ Blank	☐ TWA ☐ STEL ☐ Ceiling ☐ Environmental Standard	Reported Job Title	☐ Sample Period TWA ☐ 8-Hour TWA ☐ Extended Shift TWA			Shift Duration:	Job Code	

Form 3: Supplemental Sample Detail Record

Field Sample ID:

Tools and equipment applicable to this sample

Name of Equipment Item	Model Number, other desc

Task information applicable to this sample

Task Name	Total Minutes During Shift

Exposure modifiers applicable to this sample

Name of Exposure Modifier	Potential Impact	Comments

Sample-Specific Comments:

Field Sample ID:

Tools and equipment applicable to this sample

Name of Equipment Item	Model Number, other desc

Task information applicable to this sample

Task Name	Total Minutes During Shift

Exposure modifiers applicable to this sample

Name of Exposure Modifier	Potential Impact	Comments

Sample-Specific Comments:

Form 4: Noise Dosimetry Supplementary Record

Field Sample ID:

Specify the appropriate combination of criterion & doubling rate to be recorded for this dosimetry record:

	Agency	Threshold	Criterion	Doubling
☐	OSHA	80 dBA	90 dBA	5 dB
☐	Canada	87 dBA	87 dBA	3 dB
☐	ACGIH	80 dBA	85 dBA	3 dB

Shift Duration (min):	**8-hr Projected TWA:**	**Peak:**	**Max:**

Field Sample ID:

Specify the appropriate combination of criterion & doubling rate to be recorded for this dosimetry record:

	Agency	Threshold	Criterion	Doubling
☐	OSHA	80 dBA	90 dBA	5 dB
☐	Canada	87 dBA	87 dBA	3 dB
☐	ACGIH	80 dBA	85 dBA	3 dB

Shift Duration (min):	**8-hr Projected TWA:**	**Peak:**	**Max:**

Field Sample ID:

Specify the appropriate combination of criterion & doubling rate to be recorded for this dosimetry record:

	Agency	Threshold	Criterion	Doubling
☐	OSHA	80 dBA	90 dBA	5 dB
☐	Canada	87 dBA	87 dBA	3 dB
☐	ACGIH	80 dBA	85 dBA	3 dB

Shift Duration (min):	**8-hr Projected TWA:**	**Peak:**	**Max:**

Field Sample ID:

Specify the appropriate combination of criterion & doubling rate to be recorded for this dosimetry record:

	Agency	Threshold	Criterion	Doubling
☐	OHSA	80 dBA	90 dBA	5 dB
☐	Canada	87 dBA	87 dBA	3 dB
☐	ACGIH	80 dBA	85 dBA	3 dB

Shift Duration (min):	**8-hr Projected TWA:**	**Peak:**	**Max:**

Field Sample ID:

Specify the appropriate combination of criterion & doubling rate to be recorded for this dosimetry record:

	Agency	Threshold	Criterion	Doubling
☐	OHSA	80 dBA	90 dBA	5 dB
☐	Canada	87 dBA	87 dBA	3 dB
☐	ACGIH	80 dBA	85 dBA	3 dB

Shift Duration (min):	**8-hr Projected TWA:**	**Peak:**	**Max:**

Field Sample ID:

Specify the appropriate combination of criterion & doubling rate to be recorded for this dosimetry record:

	Agency	Threshold	Criterion	Doubling
☐	OHSA	80 dBA	90 dBA	5 dB
☐	Canada	87 dBA	87 dBA	3 dB
☐	ACGIH	80 dBA	85 dBA	3 dB

Shift Duration (min):	**8-hr Projected TWA:**	**Peak:**	**Max:**

Field Sample ID:

Specify the appropriate combination of criterion & doubling rate to be recorded for this dosimetry record:

	Agency	Threshold	Criterion	Doubling
☐	OHSA	80 dBA	90 dBA	5 dB
☐	Canada	87 dBA	87 dBA	3 dB
☐	ACGIH	80 dBA	85 dBA	3 dB

Shift Duration (min):	**8-hr Projected TWA:**	**Peak:**	**Max:**

Form 5: Time and Motion Tracking Form

Sample ID:	Date:	Page ____ of ____

For task information, enter only the specific tasks that could significantly contribute to employee exposure, i.e., welding, torch cutting, ballast dumping, etc. Other activities which do not significantly contribute to the overall employee exposure, such as rest periods, lunch breaks, etc., may be ignored. Transfer the task names and subtotals for each task to the task information tables on *Form 3, Supplemental Sample Detail Record*.

General Notes:

General Activity (Record the general type of activity here, i.e., car cutting, frog welding, bridge work, etc. For work on cars or work equipment, also include the car number or equipment name and model number.)	**Task Information (minutes)**							**Start Time**	**End Time**	**Comments**
Subtotals										

Form 6: DRI Field Measurement Form

Direct-Reading Instrument Results					
Sample ID	**Device Type**	**SN/ID**	**Contaminant**	**Time**	**Measurement Result** (If non-detect, record as '<' with numeric value for detection limit)

Appendix B

Analytical Requirements Summary

SAP ANALYTICAL SUMMARY # OU6RR1008
SUMMARY OF PREPARATION AND ANALYTICAL REQUIREMENTS FOR ASBESTOS

SAP Title: Rail Maintenance Worker Receptor Activity-Based Sampling and Analysis Plan

SAP Date (Revision): TBD

EPA Technical Advisor: Kathryn Hernandez
(contact to advise on DQOs of SAP related to preparation/analytical requirements)

Sampling Program Overview: This document is the Rail Maintenance Worker Receptor Activity-Based Sampling and Analysis Plan (SAP) for the collection and analysis of samples of outdoor air in the immediate vicinity of rail maintenance activities that may actively disturb outdoor soil on portions of BNSF Railway Company (BNSF) Right-of-Way (ROW), which is located within Operable Unit (OU) six of the Libby, Montana, Superfund Site. This SAP addresses worker receptors that may be exposed to asbestos in air as a result of BNSF rail maintenance activities. Potential exposures will be evaluated through the collection of personal air samples (to provide valuable information for scoping the RI/FS Work Plan for OU6). A total of 14 personal air samples will be collected.

Index ID Prefix: BA = Air

Medium-Specific TEM/PCM Preparation and Analytical Requirements for Field Samples:

Medium Code	Medium, Sample Type	Preparation Details				Analysis Details			Applicable Laboratory Modifications (c)
		Investigative? (a)	Indirect Prep? (a,b)		Filter Archive? (b)	Method(s)	Recording Rules	Analytical Sensitivity/ Stopping Rules	
			With Ashing (b)	Without Ashing (b)					
A	Outdoor ABS Worker Air Samples	Yes	Yes Based on Analyst's Judgement	No	Yes	TEM ISO 10312	All Asbestos structures counted; L: ≥0.5µm AR: ≥3:1	Count until 1 is achieved: i) Target S = 0.0001 cc-1(d), ii) 50 LA found, or iii) 0.5 mm^2 of filter is evaluated	LB-000016, LB-000016a, LB-000019, LB-000028, LB-000029, LB-000029a, LB-000029b, LB-000030, LB-0000031, LB-000031a, LB-000045, LB-000053, LB-000066, LB-000084, LB-000085

(a) See LB-000053 for additional details
(b) See most current version of EPA-LIBBY-08 for preparation details
(c) Use most recent versions of listed modifications
(d) Target sensitivity is set at 0.0001 cc-1; however, according to the Field Change Order (FCO) #17-1 (attached), sensitivity was adjusted to 0.0024 cc-1.

TEM/PCM Preparation and Analytical Requirements for Quality Control Samples:

Medium Code	Medium, Sample Type	Preparation Details			Analysis Details			Applicable Laboratory Modifications (c)
		Indirect Prep?		Filter Archive? (b)	Method(s)	Recording Rules	Stopping Rules	
		With Ashing (b)	Without Ashing (b)					
B	Field Blank	No	No	Yes	TEM ISO 10312	All Asbestos structures counted; L: ≥0.5µm AR: ≥3:1	Count until 1 is achieved: i) Target S = 0.0001 cc-1(d), ii) 50 LA found, or iii) 0.5 mm^2 of filter is evaluated	LB-000016, LB-000016a, LB-000019, LB-000028, LB-000029, LB-000029a, LB-000029b, LB-000030, LB-0000031, LB-000031a, LB-000045, LB-000053, LB-000066, LB-000084, LB-000085
C	Lot Blank	No	No	Yes	TEM ISO 10312	All Asbestos structures counted; L: ≥0.5µm AR: ≥3:1	Count until 1 is achieved: i) Target S = 0.0001 cc-1(d), ii) 50 LA found, or iii) 0.5 mm^2 of filter is evaluated	LB-000016, LB-000016a, LB-000019, LB-000028, LB-000029, LB-000029a, LB-000029b, LB-000030, LB-0000031, LB-000031a, LB-000045, LB-000053, LB-000066, LB-000084, LB-000085

(d) Target sensitivity is set at 0.0001 cc-1; however, according to the Field Change Order (FCO) #17-1 (attached), sensitivity was adjusted to 0.0024 cc-1.

PLM Preparation and Analytical Requirements:

Medium Code	Medium, Sample Type	Preparation Method	Analysis Method	Applicable Laboratory Modifications

Laboratory Quality Control Frequencies:

TEM: Lab Blank – 4%
Recount Same – 1%
Recount Different – 2.5%
Verified Analysis – 1%
Repreparation – 1%
Interlab – 0.5%

PLM: Lab Duplicate – ____%
Interlab – ____%

Requirements Revision:

Revision #:	Effective Date:	Revision Description

Analytical Laboratory Review Sign-off:

- ☐ Batta [sign & date: _____]
- ☐ EMSL-Libby [sign & date: _____]
- ☐ EMSL – Westmont [sign & date: _____]
- ☐ EMSL – Beltsville [sign & date: _____]
- ☐ ESAT [sign & date: _____]
- ☐ Hygeia [sign & date: _____]
- ☐ MAS [sign & date: _____]
- ☐ RESI [sign & date: _____]

[Checking the box and initialing above indicates that the laboratory has reviewed and acknowledged the preparation and analytical requirements associated with the specified SAP.]